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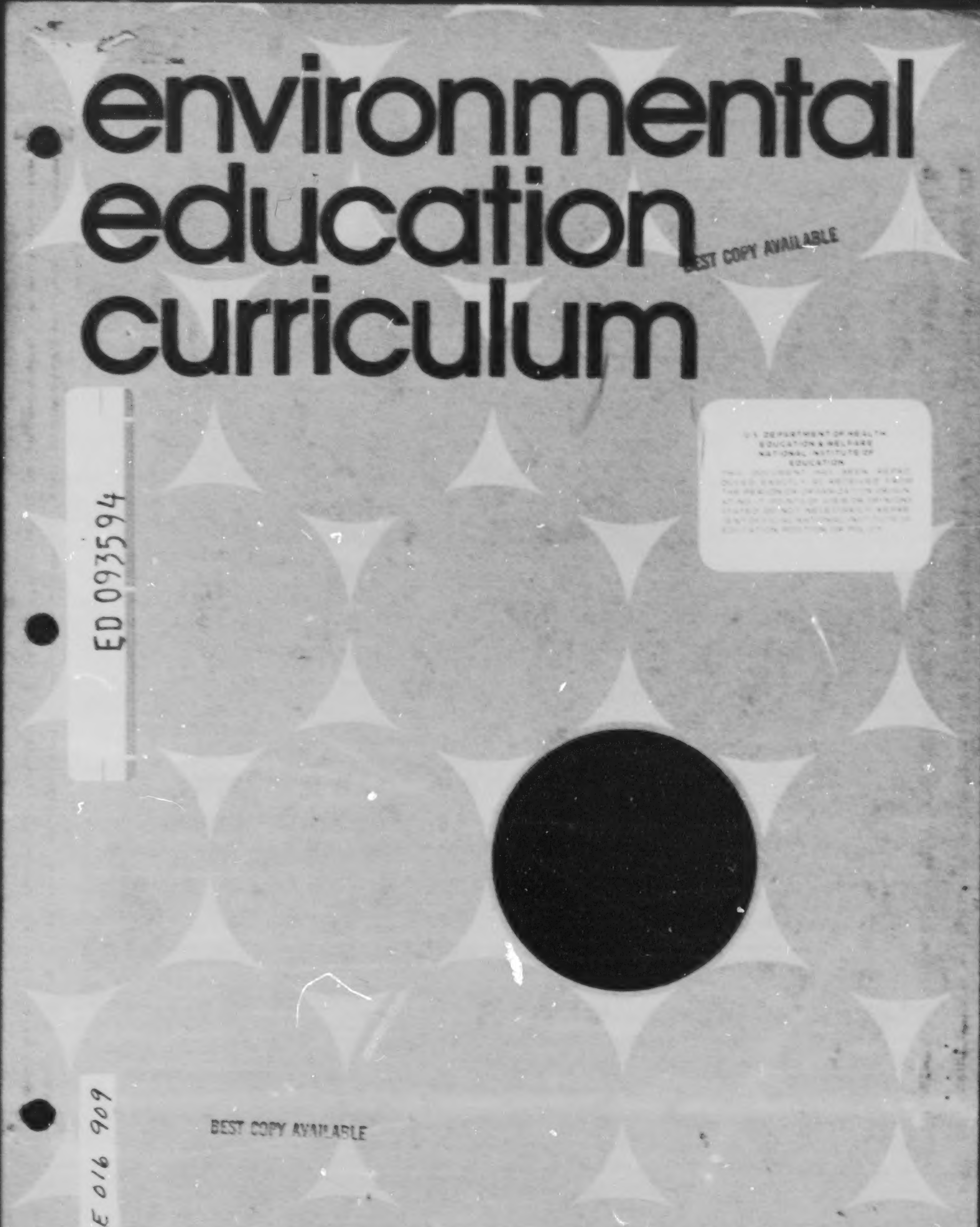
ABSTRACT

This unit presents materials to develop some of the basic knowledge necessary for grasping the complex processes associated with environmental relationships. It is divided into five topics: (1) Basic Needs for Life--the biological necessities of plants and animals; (2) Food Web--the interactions between organisms; (3) Observational Skills--ways people can become more aware of their surroundings; (4) Field Trip--first hand observation and data collection; and (5) Environmental Changes: Natural and Man Influenced--the effects man has on natural changes. For each topic there are behavioral objectives, student activities, and teacher suggestions. Special teaching aids are found in the appendix. (JP)



environmental education curriculum

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ENVIRONMENTAL EDUCATION PROJECT
ESEA TITLE III, SECTION 306

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A unit developed by the Environmental
Education Project Staff, August, 1972,
revised August, 1973 for intermediate
level elementary school students.

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ENVIRONMENTAL

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Environmental Fundamentals

Foreword

A common problem in today's society is the lack of understanding of the basic ecological processes involved in the various environmental problems. It is the intent of the material in this unit to develop some of the basic knowledge necessary for grasping the complex processes associated with environmental relationships. Every attempt should be made to integrate the activities into all curriculum areas. This unit is not intended to dictate a given set of environmental beliefs, but to present basic information on which each student can establish his own environmental beliefs.

This unit is divided into five topics.

1) Basic needs for life - the biological necessities of plants and animals.
2) Food web - the interactions between organisms.
3) Observational skills - ways people can become more aware of their surroundings.
4) Field trip - first hand observation and data collection.
5) Environmental changes: Nature and Man Influenced - the affects man has on the natural changes.

For each topic there are behavioral objectives, student activities and teacher suggestions. To facilitate use of the material, the objectives are listed separately. The numbers in parentheses above the teacher suggestions indicate which objectives the activity helps develop. Special teaching aids are located in the appendix. They can be removed for duplication and other use.

Teachers are not expected to use all the activities presented in the unit. The basic or minimum material that can be used to accomplish the unit objectives is (*) starred. The starred activities or comparable activity should be taught. Teachers should feel free to modify or substitute activities, while preparing students to accomplish the unit's objectives. For those teachers desiring to emphasize certain areas, the unit includes several additional activities.

Glenn Clarkson

Glenn Clarkson
Elementary Program Specialist

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The enclosed curriculum is the result of input from the project's paraprofessionals and volunteers, sixth-grade teachers, Community Council members, parents, students, and interested lay citizens.

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Donald French
Donald French
Project Coordinator

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UNIT GOALS AND BEHAVIORAL OBJECTIVES

Following the study of this unit, "Environmental Fundamentals," each student will:

1) Gain knowledge about the basic needs of plants and animals.
2) Better understand and appreciate the value of the interactions necessary for life to exist.
3) Increase his ability to observe using the senses and strand concepts.
4) Use his senses and strand concepts in observing the environment.
5) Collect data from various types of habitats.
6) Develop an appreciation for quality environment.
7) Explore the effect of natural and man-influenced changes in the environment.

These goals are further defined through the use of behavioral objectives. The behavioral objectives establish a predetermined goal toward which learning is to be directed and by which attainment may be measured. This unit is intended to develop student changes in both the cognitive (knowledge) and the affective (attitude) domains. The behavioral objectives for this unit contain: (1) experiences designed to develop conditions for achieving the expected behavior (learning activity), (2) the expected criterion-number of students who should achieve the behavior in an average class (80 percent), (3) the audience for which the behavior is expected (participating students), (4) the method by which the evaluation will occur (multiple-choice questions), and (5) the expected behavior (selecting the correct answer).

The present trend in education is toward more educational accountability. Behavioral objectives help define some of the desired outcomes for which education can be accountable. Student learning is not all at the same level. For example, direct recall of a fact requires fewer mental manipulations than applying a concept to a new situation. One system for indicating the level of difficulty of a desired response is through the use of Bloom's taxonomy. The higher the Bloom's number assigned, the higher the level of the competence with a particular concept. Following are descriptions of each of Bloom's levels assigned to each objective.

Knowledge Level

1.12 Knowledge of Specific Facts
1.21 Knowledge of Convention
1.22 Knowledge of Trends and Sequences
1.23 Knowledge of Classifications and Categories
1.24 Knowledge of Criteria
1.25 Knowledge of Methodology
1.30 Knowledge of Universals and Abstractions in a Field
1.31 Knowledge of Principles and Generalizations
1.32 Knowledge of Theories and Structures

Intellectual Level

2.10 Translation
2.20 Interpretation
2.30 Extrapolation
3.30 Application

The following behavioral objectives are intended to give teachers direction during the teaching of this unit. The behavioral objectives define only key concepts basic to the entire unit. They do not define all the learning experiences that will occur. The stated behavioral objectives can be used by the classroom teacher to measure student progress toward the overall unit goals.

COGNITIVE DOMAIN OBJECTIVES

The study of Topic I (Basic Needs of Life) will enable participating students on a multiple-choice question to select:

Bloom's Level	Objective
1.12	1) ...any two members of the set "sunlight, carbon dioxide, water and minerals" as materials necessary for plants to live and produce food.
1.12	2) ...any two members of the set "food, water, and oxygen" as basic biological needs of man.
1.24	3) ..."providing material for growth" as an important reason the body needs food.
2.10	4) ...the choice applying the concept "food supplies material and energy for all animals" to a specific animal.
1.12	5) ..."release energy from food" as the reason people use oxygen.
1.12	6) ...any two members of the set ""removing waste, lubricating body parts, and cooling the body" as the way people use water within the body.
1.12	7) ... "sunlight" as the source of energy for all green plants.
1.12	8) ..."green plants" as the group of organisms capable of manufacturing food.

The study of Topic II (The Food Web) will enable participating students on a multiple-choice question to select an answer:

Bloom's Level	Objective
2.20	9) ...applying the concept "green plants supply energy needed for all animals" to a set of specific animals.
1.31	10) ...applying the concept "all plants and animals in a food web affect each other's lives" to explain the relationship between a set of specific plants and animals.
1.24	11) ...from a list containing different results of decay, "to release material for use by other organisms" as the most important reason for letting plants and animals decay.
1.23	12) ...correctly labeling producer, consumer, and decomposers in a food chain.
1.23	13) ...correctly describing the relationship between two organisms. (For example: hawk - mouse as a predator - prey.)
2.20	14) ... describing the relationship between a series of specific organisms within the food web as a food chain.
1.23	15) ...describing a specific common green plant as a producer.

Cognitive Domain Objectives (Continued)

1.23 16) ...indicating they recognize the members of the group, "consumers".

1.23 17) ...indicating they recognize the members of the group, "decomposers".

2.10 18) ...indicating which population is eaten by another designated population within a given food web diagram.

1.31 19) ...applying "producers" to a specific, common producer.

1.31 20) ...indicating the "sun" is the source of energy for all living organisms.

The study of Topic III (Observational Skills) will enable participating students on a multiple-choice question to select:

1.23 21) ...an example illustrating interaction.

1.23 22) ...an example illustrating either similarity or variation.

1.23 23) ...an example illustrating adaptation.

1.23 24) ...an example illustrating either change or patterns.

2.10 25) ...a graph illustrating an increasing population.

2.20 26) ...a graph illustrating a population in balance.

The field trip experience will enable participating students on a multiple-choice question to select:

1.22 27) ..."the condition of plant life" as the best indicator of the season.

1.24 28) ..."greater space between plants" as a reliable difference between a woodland and grassland.

1.25 29) ..."animal tracks and signs" as a quick tool for determining which animals visit an area.

1.25 30) ..."leaves, bark, and twigs" as the structures one would observe to distinguish one species of tree from another.

1.22 31) ..."age" as the reason bark of a large tree looks different than the bark of a small tree of the same species.

The study of the complete unit will enable participating students on a multiple-choice question to select:

2.30 32) ...a population (in a given food chain) that increases as a result of another population decreasing within the food chain.

Cognitive Domain Objectives (Continued)

2.30 33) ...a population change (in a given food chain) that would cause a change in the non-living environment.

Example: If more plants grow, the soil will be better covered and less erosion will occur.

1.22 34) ...one of the living or non-living conditions that change with the seasons from a list including three seasonally stable conditions.

2.20 35) ...a choice applying the principle that plants prevent soil erosion.

2.30 36) ...from a food chain the organism best able to provide food for large numbers of animals.

1.12 37) ...green plants as being the largest group of living organisms.

1.24 38) ..."leaving materials where decomposers can get to it" as the best way to make sure dead matter continues to recycle.

3.00 39) ...to select the choice applying the concept that "all living organisms depend on the sun as a source of energy" to a practical problem.

1.32 40) ...a choice indicating that man influences the rate and direction of environmental changes when asked to select a sentence which best explains man's relationship to his environment.

1.31 41) ...,"natural conditions" as the factor most influencing the location of cities and farms.

1.12 42) ..."the living and non-living things around us" as the definition of environment.

AFFECTIVE GOALS

After studying the curriculum material included in this unit, students will:

1) Want to learn more about the environment.
2) Become involved in recycling activities.
3) Defend and obey environmental laws designed to protect our environment.
4) Advocate reserving "open space" areas.
5) Not intentionally destroy trees.
6) Discuss with others observations they make about their environment.
7) Use all appropriate senses when making comparisons of specific things found in the environment.
8) Observe more living things in the environment.
9) Relate their increased interest in the environment to their use of more senses.
10) Be concerned with our present environmental conditions and the conditions that would result if all our plants were destroyed.
11) Encourage activities that support the "balance of nature" concept.
12) Place a high value on preserving endangered species.
13) Value organisms like spiders, snakes, and insects.
14) Express disagreement with those that advocate indiscriminate killing of spiders, snakes, and insects.
15) Not destroy the homes of wildlife.
16) Value plants and animals that are only indirectly related to man's food supply, as well as those that man depends upon directly.
17) Believe that there were human behaviors that were acceptable 100 years ago that are not acceptable today because they help contribute to our pollution problems.
18) Support the use of an impact statement before man alters the environment.
19) Be willing to limit personal desires in favor of a better environment.
20) Discuss their learning experiences with parents and friends.
21) Reduce individual behaviors that contribute to pollution problems.
22) Agree with the statement that people cannot use the environment in any way they wish.

BEHAVIORAL OBJECTIVE SUMMARY SHEET

Behavioral Objective Number	Major Concept Within the Objective	Bloom's Taxonomy Level	Growth Expected Between Pre and Post Testing*	Suggested Activities To Help Develop The Objective	Test Question Number
1.	Sunlight, carbon dioxide, and water are necessary for plants to live.	1.12	10%	1.3 - 1.7, 2.5, 2.6	1
2.	Food, water, and oxygen are biological needs of man.	1.12	10%	1.3, 1.8, 1.13 - 1.19	21
3.	Food provides material for body growth	1.24	10%	1.3, 2.19	2
4.	Energy and matter for animals comes from food.	2.10	20%	1.8, 1.15, 1.18, 1.19	25
5.	Oxygen is used by animals to release energy from food.	1.12	10%	1.17, 1.18	3
6.	Removing waste, lubricating body parts, and cooling the body are some ways animals use water.	1.12	25%	1.9 - 1.12, 1.15, 1.16	26
7.	Sunlight is the source of energy for all green plants.	1.12	25%	1.4 - 1.6, 2.3, 2.5, 2.6, 2.18	4
8.	Only green plants are capable of manufacturing food.	1.12	20%	1.4 - 1.6, 2.1, 2.3 - 2.9	27

*Expected growth is based on two years test results from over 5,000 Topeka sixth grade students.

Behavioral Objective Summary Sheet (Continued)

Behavioral Objective Number	Major Concept Within the Objective	Bloom's Taxonomy Level	Growth Expected Between Pre and Post Testing	Suggested Activities To Help Develop The Objective	Test Question Number
9.	Green plants supply the energy needed for all animals.	2.20	10%	1.5, 2.1, 2.3 - 2.9, 4.2, 4.3	5
10.	All plants and animals in a food web effect each others lives.	1.31	20%	1.3, 2.1 - 2.4, 2.22, 3.10	28
11.	Dead plants and animals need to decay so material in their bodies can be used by other organisms.	1.24	10%	2.16, 4.2, 4.3	6
12.	Identify a correctly labeled food chain.	1.23	25%	2.4, 2.22, 2.23, 4.3	19
13.	Catagorize and label organism pairings: Example: rabbit - grass - consumer - producer.	1.23	15%	2.8 - 2.16, 2.20, 2.22, 2.23	7
14.	Identify a food chain from within a food web.	2.20	10%	2.4, 2.22, 2.23, 4.2, 4.3	39
15.	Identify a common producer.	1.23	25%	2.5, 2.6, 2.23, 3.2, 4.3	8
16.	Identify a common consumer.	1.23	25%	2.7 - 2.9, 2.23, 3.2, 4.3	29
17.	Identify a common decomposer.	1.23	20%	2.16, 2.17, 3.2, 4.2, 4.3	9

Behavioral Objective Summary Sheet (Continued)

Behavioral Objective Number	Major Concept Within the Objective	Bloom's Taxonomy Level	Growth Expected Between Pre and Post Testing	Suggested Activities To Help Develop The Objective	Test Question Number
18.	Select a population that is eaten by a designated population in a food web.	2.10	15%	2.2, 2.9, 2.22, 2.23, 4.3	40
19.	No living organism is the source of food for producers.	1.31	5%	2.1 - 2.3, 2.5	10
20.	The sun is the source of energy for all living organisms.	1.31	20%	1.5, 2.2, 2.5, 2.18	32
21.	Select an example illustrating interaction.	1.23	15%	Most of the activities in Topics III, IV, and V.	11
22.	Select an example illustrating either similarity or variation.	1.23	10%	Most of the activities in Topics III, IV, and V.	35
23.	Select an example illustrating adaptation.	1.23	25%	Most of the activities in Topics III, IV, and V.	16
24.	Select an example illustrating either change or patterns.	1.23	20%	Most of the activities in Topics III, IV, and V.	41
25.	Select a graph illustrating an increasing population.	2.10	15%	3.20 - 3.26	37
26.	Select a graph illustrating a population in balance.	2.20	10%	3.20 - 3.22	38

Behavioral Objective Summary Sheet (Continued)

Behavioral Objective Number	Major Concept Within the Objective	Bloom's Taxonomy Level	Growth Expected Between Pre and Post Testing	Suggested Activities To Help Develop The Objective	Test Question Number
35.	Plants can prevent soil erosion.	2.20	20%	4.1 - 4.3, 3.26	18
36.	More food energy is available from producers than from its consumers in a food chain.	2.30	15%	2.19	14
37.	Green plants are the largest group of organisms.	1.12	15%	2.5, 2.6, 2.19	31
38.	Leaving material where decomposers can get to it is the best way to make sure matter continues to recycle.	1.24	30%	2.16, 2.17, 4.3	22
39.	Apply the concept that all living organisms depend on the sun.	3.00	10%	2.5, 2.6, 2.19, 4.3, 4.8	33
40.	Man influences the rate and direction of environmental changes	1.32	10%	3.11, 3.23 - 3.26, Topics IV and V	17
41.	Natural environmental conditions influenced man's decisions in locating cities and farms.	1.31	10%	4.1, 5.2 - 5.4	36
42.	The environment is the total living and non-living things around us.	1.12	20%	1.1, Topics II - V	42

Behavioral Objective Summary Sheet (continued)

Behavioral Objective Number	Major Concept Within the Objective	Bloom's Taxonomy Level	Growth Expected Between Pre and Post Testing	Suggested Activities To Help Develop The Objective	Test Question Number
27.	The condition of plant life varies with the season.	1.22	20%	3.10, 3.23, 3.26, 4.3, 5.1	12
28.	There is greater space between plants in a woodland area than in a grassland area.	1.24	20%	2.21, 3.10, 4.2, 4.3, 4.8	15
29.	Animal tracks and signs are good quick indicators of life present in an area.	1.25	20%	3.10, 4.3	13
30.	Observe leaves, bark, and twigs to distinguish one tree species from another.	1.25	10%	4.2, 4.3	34
31.	The bark of trees change as they get older.	1.22	10%	4.2, 4.3	20
32.	As one population increases in a food chain another population in the food chain decreases.	2.30	20%	2.9, 3.22, 4.3	30
33.	Population changes can cause changes in the non-living environment.	2.30	20%	2.23, 3,24, 3.26, 4.3, 5.1, 5.4	23
34.	Some living and non-living conditions change with the seasons.	1.22	10%	4.1 - 4.5, 5.1	24

ACTIVITIES SUMMARY SHEET

TOPIC I.

Activity Number	Topic	Behavioral Objectives the Topic Helps Develop
1.1	Construct Montages	42
1.2	Student Environmental Notebooks	All objectives
*1.3	List Plant and Animal Needs	1, 2, 3, 10
1.4	View "Green Plants and Sunlight	1, 7, 8
*1.5	Class Discussion About Food Manufacturing	1, 4, 7, 8, 9, 20
1.6	Construct a Montage or Bulletin Board Illustrating Food Production	1, 7, 8
1.7	Grow Plants Under Several Experimental Conditions	1
1.8	Review Animal Needs	2, 4
*1.9	Discuss the Ways Animals Use Water	6
1.10	Illustrations of Methods Animals Use Water to Cool Their Bodies	6
1.11	Demonstration Illustrating the Lubricating Effects of Water	6
1.12	Demonstration Illustrating the Cleaning Effects of Water Within the Body	6
1.13	Discuss the Water Cycle	1, 2, 21
1.14	Demonstrate the Cleaning Effects of Evaporating Water	1, 2
1.15	View "Hemo the Magnificent"	2, 4, 6
1.16	Determine the Amount of Water a Person Uses	2, 6
1.17	Demonstrate the Amount of Oxygen in the air	2, 5
*1.18	Demonstrate a Use for Oxygen by Burning a Sample of Food Like a Peanut	2, 4, 5
1.19	Work With the "NASA - Lost on the Moon Exercise"	2, 4

TOPIC II.

Activity Number	Topic	Behavioral Objectives the Topic Helps Develop
2.1	Research the Needs, Habits, and Life Style of an Organism	8, 9, 10, 19, 21
*2.2	Food Web Exercise	10, 18, 19, 20
*2.3	Defining and Illustrating the Food Web	7, 8, 9, 10, 19, 21
*2.4	Defining and Illustrating the Food Chain	8, 9, 10, 12, 14
*2.5	Discuss Producers	1, 7, 8, 9, 15, 19, 20, 21, 37, 39
2.6	Discuss a Film Illustrating Food Production	1, 7, 8, 15, 37, 39
*2.7	Discuss Consumers	8, 9, 16
2.8	Define and Discuss the Role of Herbivores	8, 9, 13, 16
2.9	Define and Discuss the Role of Carnivores and Omnivores	8, 9, 13, 16, 18, 32
*2.10	Define and Discuss Predator-Prey Relationships	13, 21

*The minimum or basic material that will accomplish the unit goals.

TOPIC II. (Continued)

Activity Number	Topic	Behavioral Objectives the Topic Helps Develop
2.11	View One of the Films Illustrating Predator-Prey Relationships	13, 21, 23
2.12	Define and Discuss Parasite-Host Relationships	13, 21, 23
2.13	View Parasite Life Cycles	13, 21, 23
2.14	Have Students do Research on a Selected Parasite	13, 21, 23
*2.15	Define and Discuss the Roles of Scavengers	13, 21, 23
*2.16	Define and Discuss Decomposers	10, 11, 13, 17, 21, 23, 33
2.17	Observe Decomposing Material	17, 38
*2.18	Discuss Energy Path	7, 9, 20
*2.19	Defining the Matter Cycle	3, 4, 36, 37, 39
*2.20	Discuss Competition	13, 21
*2.21	Discuss Adaptation	23, 28
2.22	Reading and Interpreting Food Web Using Pictures	10, 12 - 18
2.23	Read Short Articles Illustrating Various Food Web Concepts	12 - 18, 33, 40, 42

TOPIC III.

Activity Number	Topic	Behavioral Objectives the Topic Helps Develop
*3.1	Briefly Discuss the Strand Concepts	21, 22, 23, 24
*3.2	Observe the School Yard Environment using the Student Observation Sheet	15, 16, 17, 21, 22, 23, 24
*3.3	Experiment With the Sense of Touch	21, 22, 23, 24
3.4	Use the Blind Walk to Increase One's Use of the sense of touch	21, 22, 23, 24
*3.5	Experimenting With the Sense of Taste	21, 22
*3.6	Experimenting With the Sense of Smell	21, 22
*3.7	Observing With the Sense of Hearing	21, 22
3.8	Write a Story About a Tree	10, 21, 23, 24
3.9	Increase Observation and the Use of Adjectives Through Property Bingo	22, 23, 24
*3.10	Students Become Aware of the Amount of Life That Can Exist in a Small Space by Doing a Quadrat Study	10, 21, 22, 23, 24, 27, 28, 29
3.11	View the film "What Ecologists Do"	21, 22, 23, 24, 40, 42
*3.12	Observe the Detailed Structure of Plants and Animals	21, 22, 23, 24
3.13	Discuss Student Observations	21, 22, 23, 24
3.14	Studying Adaptation Through the Use of Toothpicks	23
3.15	Collect Data for Developing the Concepts of Variation and Similarity Through the Use of a Personal Data Sheet	22
3.16	Construct Histograms (graphs) Illustrating Variation and Similarity Within the Data From the Personal Data Sheet	22, 23
3.17	Observe Natural Patterns	22, 24
3.18	Establish and Observe Change Jars	21, 22, 24

TOPIC III. (Continued)

*3.19	Establish Plants and Animals in the Classroom	21, 22, 23, 24
*3.20	Discuss Changes as Illustrated by Populations	10, 21, 23, 24, 25, 26, 42
3.21	Construct Population Graphs Illustrating Environmental Factors Effecting Population Size	10, 21, 23, 24, 25, 26, 42
3.22	Discuss the Snowshoe Hare Graph as an Illustration of a Population in Balance With Nature	21, 24, 26, 32
3.23	Discuss the Ring-Neck Pheasant Population Illustrating a Favorable Environment	21, 24, 25, 27, 40
3.24	Discuss the U. S. Population Graph as an Example of the Changing Rate of Increase	21, 24, 25, 33, 40
3.25	Calculate the Density of the United States	22, 24
3.26	Discuss the Kansas Population Graph as an Example of How Environmental Factors Affect Population Size	21, 24, 25, 27, 33, 35, 40, 42

TOPIC IV.

*4.1	River Road Sites	21, 22, 23, 24, 34, 35, 40, 41, 42
*4.2	Morning Observation Session	9, 10, 11, 14 - 18, 21, 22, 23, 24, 27, 28, 30, 31, 34, 35, 40
*4.3	Habitat Studies	9 - 18, 21, 22, 23, 24, 27 - 35, 38, 39, 40, 42
4.4	Return Trip	
*4.5	Observing Micro-organisms in the Water Samples	21, 22, 23, 34, 42
4.6	Field Trip Discussion	All objectives of Activities 4.1, 4.2, 4.3
4.7	Transfer the Data From Data Sheets to Habitat Comparison Sheet	22, 23
4.8	Discuss and Compare the Various Habitats	15, 16, 17, 18, 21, 22, 23, 24, 28, 39, 40, 42

TOPIC V.

*5.1	View One of the Films Illustrating Natural Succession	21, 24, 27, 33, 34, 40
*5.2	View and Discuss Examples of Succession Where Man Has Altered the Rate of Change	21, 24, 40, 41, 42
*5.3	Examine and Discuss How Man Is Using and Influencing the Local Environment	21, 23, 24, 40, 41, 42
5.4	Students Examine Their Local Environment	21, 22, 23, 24, 33, 40, 41, 42
5.5	Discuss Pollution Caused by Each Family	40
5.6	Paper Collecting	40
5.7	Aluminum Collection	40

ENVIRONMENTAL FUNDAMENTALS

Suggested Time Line for Unit Activities

Day	
Before the field trip:	
X	Arrange the field trip date with the project staff as early in the school year as possible. Obtain approval of the field trip date from the building principal. Contact the project office concerning student pre-tests before teaching any of the unit.
X to 0	Teach the starred activities of Topics I, II, and III of the unit before going on the field trip. Time required will vary with each class.
10	Prepare copies of the parent letter or field trip permission slips, as directed by the principal.
7	Send parent letters or permission slips home with students. Invite parents and your principal to go along on the field trip.
5	Make copies of the data sheet for use on the field trip (two copies per each student)
4	Discuss with the students the field trip day's activities. This information is in Topic IV of the unit.
3	Become familiar with the activities immediately following the field trip.
2	Locate and become familiar with the microprojector for use following the field trip.
1	Have signed parent permission slips for each student, if required by your principal. Remind the students to dress for the outdoors and to bring a sack lunch.
Field Trip	
0	Place a name tag on each student. See that each student has a sack lunch, ballpoint pen or pencil, and water sample bottle (optional). Give the data sheets to the project staff before leaving the school. Collect cider slush money, if your group is going to get a cider slush. Have the students use the restroom before leaving the school. Have the students ready to leave by 8:50 a.m.
Following the Field Trip:	
-1	View the microorganisms in the water samples using the microprojector.
-2	Transfer data from data sheets to habitat comparison sheets. Discuss the variations and similarities in the habitats.
-3 to -X	Teach the starred activities of Topic V.
-X	Administer the posttest as soon as you have completed teaching the unit (call the project office when you are ready to test).

ENVIRONMENTAL FUNDAMENTALS

TOPIC I: BASIC NEEDS FOR LIFE

1.0
Introduction

1.0
This topic is intended to develop student awareness and understanding of the basic biological necessities for plant and animal life as they exist on the earth.

1.1
Construct montages

1.1 (42)
Have students individually or in small groups construct montages. This activity will help you to interpret the students' meaning for the word environment, as well as gather impressions, feelings, and views students have concerning the environment.

For each montage to be constructed have available a 3 foot by 3 foot sheet of paper (brown wrapping paper will do), on to which students can glue pictures and objects, write words, draw pictures, or in any other way express their thoughts about the environment. Have available numerous magazines, newspapers, etc., from which pictures and words can be cut.

As you are discussing the students' montages, encourage them to explain why they included certain items, but Do Not judge their selection in terms of being right or wrong. Help each student decide why he included each item. Accept their feelings and interpretation of their environment. Encourage students to express their views.

During later sections of the unit, you can refer back to ideas students expressed in their montages. For example, when discussing the sun as a source of energy, consider what they included as an energy source, if any. If they included the sun, why did they?

If the student enjoyed compiling the montage, it could prove worthwhile to save these montages and compare them with one constructed after completing the unit material. Students may wish to take their montage home to hang on the wall of their room.

1.2
Start student environmental notebooks

1.2 (all objectives)
Students should start an environmental notebook. The notebook could contain conclusions from various unit activities, new words, environmental related news clippings, student ideas and expressions, and various drawings. The notebook should be loosely structured so students can freely add materials.

1.3
Discuss and list plant and animal needs

1.3 (1, 2, 3, 10)
The purpose of this activity is to determine the needs of plants and animals, but much emphasis should be directed toward the fact that no life exists independent of other life or its surroundings.

*1.3
Discuss and list
plant and animal
needs
(Continued)

1.3 (1, 2, 3, 10)
As the students state various needs list them in one column on the chalkboard. Encourage the students to think of their own needs or desires. What do they get "free" and what do they pay for. The list could include such words as space, oxygen (air), water, food, love, carbon dioxide (air), clothing, warmth, rest, sunlight, fun, minerals, companions, shelter, friends, energy, bathing, candy, etc.

Once a list is compiled, have the students place a (P) in front of those words representing plant needs and an (A) in front of those words representing animal needs. Some may be both plant and animal needs. Now have the students circle the biological needs--those needs without which plants and animals would soon die. The biological needs of plants are sunlight, carbon dioxide, water and minerals. The biological needs of animals are food, oxygen and water. If the students' list has not included all the biological needs, bring them to their attention. Students should realize biological needs are different from social or personal needs. Explain that biological refers to life or living. You can divide the word biological into "bio" - meaning life and "logical" - meaning study. Have the students look on cans and containers for words containing "bio" as part of the word. Most new detergents are bio degradable meaning they can be broken down, or decomposed, by bacteria and other micro-organisms. Suggest students put the term "biological" in the section for new words in their notebooks.

Have students discuss times when their needs were not fulfilled. As they describe their individual incidents, have them decide if it was a biological need, social need, or some other type. Ask if we have as much trouble meeting our biological needs as people in other countries. Have the students collect pictures illustrating people not getting sufficient food--a biological need. Explain social and personal needs are real and do affect people's lives, but we are now going to talk about biological needs and how they are met in the environment.

Have the students record the results of this activity in their notebook.

*1.4
View "Green Plants
and Sunlight" or a
comparable film
(See Appendix A)

1.4 (1, 7, 8)
The film "Green Plants and Sunlight" will serve as an excellent introduction and source of information about plant needs. Have your media specialist request the film for you. The film uses some terms you will want to explain or discuss. Read the film summary in Appendix A before showing the film. The films "Learning About Leaves" and "Plants Make Food" will also serve as an introduction to plant needs and food production.

*The basic or minimum material that can be presented to achieve the unit objectives.

*1.5
Class discussion
about food
manufacturing

1.5 (1, 4, 7, 8, 9, 20)
In the class discussion following the viewing of the film, emphasize: (1) what the plant used (minerals, carbon dioxide, water, sunlight), (2) what happened in the plant (material and energy were combined to make food), (3) what was the end product (food in the form of sugar is used for plant growth), and (4) what did the plant release (oxygen)?

Bring out the point only plants (land or water) containing chlorophyll are able to make food and release oxygen. Define food as a combination of material and energy. This definition will be built upon later. If you wish, you can use the term photosynthesis, but it is not necessary. If you do, explain that "photo" refers to light and "synthesis" refers to putting together. Photosynthesis means putting together by using light.

To summarize the needs, activities, and products of green plants, use the "Sunlight and Green Plant Interaction" diagram in Appendix E, either as a student handout or transparency.

Ask questions such as: (1) What will happen if smog gets so thick that sunlight cannot reach the plants?, (2) What will happen if the water contains harmful materials?, (3) Does the quality of air surrounding a plant affect it?, and (4) What will happen to water plants if the water contains harmful chemicals?

1.6
Construct a montage
or bulletin board
illustrating food
production

1.6 (1, 7, 8)
The montage or bulletin board display will give those having trouble grasping all that is happening in plants a chance to view the process over a period of time. They may want to sketch the montage or bulletin board diagram in their notebooks.

1.7
Grow plants under
several experimental
conditions

1.7 (1)
These topics could be used for experiments: (1) amount of light available, (2) amount of water available, (3) types of soil, (4) colors of light, (5) kinds of light, and (6) amount of soil.

Tomatoes, radishes, corn, beans, and sunflower seeds work very well in classroom experiments. Milk cartons filled with soil will work as pots. Have the students working in pairs and test the effect of limiting or varying plants' needs. Discuss the need to: (1) define what it is they are testing, (2) have a control plant as well as an experimental plant, (3) care for the experiment, (4) record data, and (5) clean up when the experiment is over.

*1.8 Review animal needs	1.8 (2, 4) Briefly review those things the students considered to be biological needs of animals. Animals are not able to produce their own food like green plants and, therefore, must depend directly or indirectly on green plants for their food. Declining environmental conditions can affect animals directly or indirectly by destroying plants or animals they depend upon for food. Few students realize how the body (man's or any other animal's) uses food, oxygen, and water other than for eating, breathing, or drinking. Students will understand why we are concerned about the quality of the environment if they have some understanding of how our body uses water, oxygen, and food.
*1.9 Discuss the ways animals use water	1.9 (6) Water is the most easily explained and understood need of the body. Of the many ways the body uses water, maintaining body temperature, removing waste, and keeping body parts moist and flexible are among the most important.
1.10 Conduct a demonstration illustrating the ways animals use water to cool their bodies	1.10 (6) The regulation of body temperature can be illustrated by placing water or alcohol on the back of the hand and blowing on it. (Alcohol works faster than water, but might cause some misleading ideas.) Record the results in the student notebooks. As the liquid evaporates, it removes heat from the body and makes the area feel cool. The same process happens when the body sweats. This is the natural way the body gets rid of excess body heat. Dogs will often be seen during the summer with their tongues hanging out providing an opportunity for their bodies to lose excess heat through evaporation of liquid on their tongues.
1.11 Conduct a demonstration illustrating the lubricating effect of water	1.11 (6) All parts of the body are constantly moving against each other and would wear out if they were not lubricated. Water serves as the lubricant for body parts. Rub the fingers together while dry and then repeat after wetting them. What effect does the water have? Record results in the notebooks.
1.12 Conduct a demonstration illustrating the cleaning effects of water within the body	1.12 (6) Set up a tube (if possible, clear, 12" long, and 1" in diameter) with a screen wire or cloth on one end in such a way that water can pass through, but sand cannot. A tube can be made by cutting the bottom from a clear plastic or glass bottle such as some floor wax comes in. Fill the tube with dirty sand. Pour clean water in the top and collect the water at the bottom. Compare the sand to the body and the dirt to the waste

1.12 Conduct a demonstration illustrating the cleaning effects of water within the body (Continued)	1.12 (6) material found in the body. Note how the water picks up the waste material and carries it out of the body. Record the results in the student notebook. Explain that the body continues to produce waste that must be removed.
1.13 Discuss the water cycle	1.13 (1, 2, 21) Examine ways the waste (dirt) in activity 1.12 can be removed from water so the water can be reused. This could lead into a discussion of the natural water cycle. A water cycle diagram is included in Appendix B for your use. Think of the sun's energy interacting with the liquid water causing it to evaporate into vapor which interacts with cool air in the atmosphere and forms clouds. Vapor within the clouds collects together and falls as rain. Only the water evaporates, thus leaving waste in the water behind.
1.14 Demonstrate the cleaning effect of evaporating water	1.14 (1, 2) Evaporate some dirty water and condense the vapors into a liquid. A sketch in Appendix E illustrates a simple setup that can be used to demonstrate evaporation and condensation. How does the recondensed water compare to the original water? Sketch a water cycle in the notebooks. Explain that this is nature's way of purifying water. Discuss how the city cleans up our drinking water.
1.15 View "Hemo The Magnificent"	1.15 (2, 4, 6) If you wish to expand upon the role of water (blood) in the body, order the film "Hemo the Magnificent" from your local Bell Telephone Office. Be sure to view it before showing it to a class as it contains many ideas that merit class discussion.
1.16 Determine the amount of water a person uses	1.16 (2, 6) Have the students search reference books to determine the amount of water their body requires per day. From this they can calculate the amount needed for longer periods of time. Can they find the amount industry uses per person per day? How could they find the amount of water a person in Topeka uses per day? (Have them look at their water bill). How many gallons of water does your family use per day, per week, per month? How much water is wasted each time we turn on a faucet waiting for water to

1.16 Determine the amount of water a person uses (Continued)	1.16 (2, 6) cool for drinking or warm up for washing? Have students suggest ways they could reduce the amount of water wasted. Record any data they collect in their notebooks.
1.17 Demonstrate the amount of oxygen in air	1.17 (2, 5) Most students have trouble distinguishing oxygen from air because both are colorless and the oxygen they think of comes from air. Try to reach a point where students realize their body uses only the oxygen portion of the air. If the students realize burning requires oxygen, you can illustrate the relative portion of air that is oxygen by burning a candle in an inverted jar over a pan of water. Place a burning candle in a shallow pan containing about two inches of water. Invert a pop bottle or gallon jar over the candle making sure water can move into the jar by having some object under the jar lip. When the candle goes out, assume the oxygen is gone. Water will move into the jar. A sketch illustrating the equipment arrangement needed is included in Appendix E. Mark the water line and estimate the portion of air that must have been oxygen. Students could sketch the setup of equipment used in the experiment and the results in their notebooks.
*1.18 Demonstrate a use for oxygen by burning a sample of food like a peanut	1.18 (2, 4, 5) To help students realize foods will release energy, place a peanut on a wire and light it with a match. Hold it over a pan in case it is dropped. Have the students feel the heat released as a result of oxygen and food interacting. The energy when released inside of the body can be used for moving, doing work, and building body parts. The solid part of the peanut, or any food, is used for body building and repair. The heat released can be measured in terms of calories, and different types of food release various amounts of energy or calories. Some students can do a special project developing charts illustrating the number of calories in various types of food. Use the "food-oxygen interaction" diagram, Appendix B, to help develop an understanding of the role of food and oxygen within animal bodies. Students should realize that animals combine oxygen with food in order to release energy. This concept should be included in their notebooks.

1.19
"NASA- Lost On The
Moon" Exercise

1.19 (2, 4)
The "Lost on the Moon" exercise can be used to review the relative importance of various needs. It can be used to re-emphasize the importance of oxygen, water, and food as man's biological necessities. This can be either a group or individual activity. If it is used as a group activity, the decision by consensus concept can be developed. This may be a new way of making decisions for the students and a worthwhile experience. The directions, activity sheet, and answers are found in Appendix E.

TOPIC II: FOOD WEB

2.0
Introduction

2.0
The food web activities are intended to develop within each student an understanding as to how organisms depend on and interact with other organisms as well as with the non-living environment. The organism (any living plant or animal) relationship diagram (Appendix E) will help the teachers understand the various organism groups discussed in this topic.

2.1
Research the needs, habits, and life style of an organism

2.1 (3, 9, 10, 19, 21)
Either assign or have each student select one organism from the list below to research. The information the student collects about the organism will be used during the food web discussion. The organism study sheet, Appendix C, will help guide the student while searching for information about the organism. Provide the students with a variety of reference material. Emphasize that every organism is part of the natural life pattern and serves some purpose within nature.

Coyote
Mouse
Rabbit
Snake
Grass
Snail
Owl
Deer
Raccoon
Vulture
Algae
Oak Tree
Cattails
Hawk
Duck
Grasshopper
Beetle
Louse
Fly
Man
Bacteria
Mold
Earthworm
Fish
Sparrow
Toadstool
Fox
Spider
Dog
Cow
Tapeworm
Corn
Beaver
Flea
Cat
Wildcat

By choosing organisms from the suggested list, you will be able to illustrate most of the common relationships. If you have fewer students than organisms suggested, be sure to select those that will illustrate the various relationships to be discussed.

If the students are not familiar with the word "organism", they may want to add it to their list of new words. A simple definition would be "any living plant or animal".

*2.2
Food Web Exercise

2.2 (10, 18, 19, 20)
The food web exercise will give the students a concrete experience from which they can develop terms and definitions to illustrate various ways organisms are interrelated. Allow at least 30 minutes for this activity. Nearly all the activities of Topic II can be integrated into a discussion during the food web exercise.

*2.2
Food Web Exercise
(Continued)

2.2 (10, 18, 19, 20)
Students should arrange their desks in a circle, leaving enough room behind so that the teacher can walk on the outside. Tape a sign with the organism's name on the front of each student's desk where all others can see. Have a skein of yarn rolled into a ball before starting the exercise.

Start by asking one student representing a consumer (for example, the coyote) to select from the other organisms one he would eat in order to obtain food. Do Not start with a producer (see activity 2.5). Connect the yarn between the "eater" and the "eaten". Continue connecting "eating" organisms to "eaten" organisms until all organisms are involved in at least one path. After discussing what some animals eat, select a green plant. If students do not realize green plants make food, rather than eat other organisms, review briefly how plants use sunlight, water, carbon dioxide, and minerals and produce food and release oxygen. Emphasize that all the other organisms depend directly or indirectly on the producers. Connect the yarn from the plants to organisms that eat the plants.

Continue connecting yarn between organisms until several of the students have two or more strings. Be sure each student realizes he represents a population (all organisms of one type), and thereby can be eaten by several others. The food web diagram, Appendix E, illustrates the way your food web might appear.

Once you have connected sufficient strings, depending on the number of relationships and concepts you wish to illustrate, have all students tape the strings to their desks. Students may want to sketch the food web they formed before leaving the circle.

The following concepts and relationships can be presented in any sequence depending on the interest of the students. You may wish to develop only a few of the concepts while the students are in a circle with others being developed at a later time. Students may wish to add new terms to their notebooks as they are introduced.

When you finish your food web you could hang the signs and strings from the ceiling or room lights. This will allow students to view the food web over a period of time.

*2.3
Defining and
Illustrating the
Food Web

2.3 (7, 8, 9, 10, 19, 21)
Ask the students what name they would use to describe the pattern formed by the yarn. After they suggest a web, explain that we will refer to this as a food web. A food web can be defined as the many interactions that exist between organisms, or a pattern to show who eats who. Make sure that students realize that each string represents an

*2.3
Defining and
Illustrating the
Food Web
(Continued)

2.3 (7, 8, 9, 10, 19, 21)
interaction of one organism with another, and that within nature many more interactions exist than are illustrated by the few strings.

You could illustrate a simple food web on the chalkboard using grass, mouse, cow, deer, coyote, hawk, man, and bacteria. Could this food web exist in nature without other animals? Would a food web for a lake be the same as that for a grassland?

*2.4
Define and
Illustrate Food
Chains

2.4 (8, 9, 10, 12, 14)
While the food web illustrates a more total picture of the interaction between organisms, the food chain illustrates a path by which food (matter and energy) moves from one organism to the next. Many food chains are formed within a food web. Food chains can be thought of as subsets of the set food web. A complete food chain starts with a producer and ends with a decomposer. Several consumers can be in between. An example of a food chain could be: grass (producer) eaten by a mouse (consumer) which in turn is eaten by a snake (consumer) which in turn is eaten by a hawk (consumer) which will die and be decomposed by bacteria (decomposer). A similar way to write the food chain would be: grass ⟶ mouse ⟶ snake ⟶ hawk ⟶ bacteria. The arrows indicate the direction in which food travels. Some references have the arrows pointing in the opposite direction. You may wish to use only lines not arrows to join organisms. Have the students find food chains within the food web formed by the class.

*2.5
Discuss Producers

2.5 (1, 7, 8, 9, 15, 19, 20, 21, 37, 39)
Of the set of all organisms, producers (green plants) are the subset that contain chlorophyll and use sunlight to produce food. They do not eat other organisms. Only producers have the ability to combine the energy from the sun, matter from the soil, and carbon dioxide from the air to produce food. In addition to making food, the producers release oxygen for animals to use.

The world's most important producer is algae. It produces around 80 percent of the world's food and oxygen. What will happen if our oceans are allowed to become polluted to the extent algae will not grow? Other producers are trees, grass, and cattails. What were the producers in the food web formed by the class?

If students ask where chlorophyll comes from, point out green plants have the ability to make chlorophyll when exposed to sunlight. The chlorophyll in turn aids in the capture of the sun's energy. Food production in a leaf can be compared to a factory making paper. The factory needs raw material like wood fiber, water, etc. The green plants need raw material like sunlight, carbon dioxide, and water. The factory has

*2.5 Discuss producers (Continued)	2.5 (1, 7, 8, 9, 15, 19, 20, 21, 37, 39) processing machines while the plants have cells and chlorophyll. The factory produces waste material, which can cause air or water pollution, and the plant produces oxygen which it releases into the air.
2.6 View and discuss one of the films illustrating food production	2.6 (1, 7, 8, 15, 37, 39) If you have not shown one of the films, "Green Plants and Sunlight," "Learning About Leaves," or "Plants Make Food," one would be appropriate to show at this time. Information about each film will be found in Appendix A.
*2.7 Discuss consumers	2.7 (8, 9, 16) Consumers are the large group of all organisms that must obtain food from other organisms. All consumers depend directly or indirectly on producers for their food supply. Develop with the students a definition of consumers.
2.8 Define and discuss the role of herbivores	2.8 (8, 9, 13, 16) Herbivores are those consumers that eat only producers (green plants) to obtain their food. Land herbivores normally have well developed incisors like cows, deer, and rabbits. Snails would be an example of an aquatic herbivore that eats algae and other plant matter.
2.9 Define and discuss the roles of carnivores and omnivores	2.9 (8, 9, 13, 16, 18, 32) The carnivores eat only other animals, while the omnivores eat both plants and animals. Which is man? Many of these consumers are specialized as predators, parasites, etc.
*2.10 Define and discuss predator-prey relationships	2.10 (13, 21) Begin by asking questions like the following: How does a hawk or a snake interact with a mouse? What happens to the mouse population as a result of this interaction? What happens to the hawk or snake population? Were there other relationships of this type in the food web developed by the class? Introduce the term predator - killer, and prey - killed. Explain that this is a part of nature and the only way many organisms have of obtaining food. The predatory process also controls the population of the prey.

2.11 View one of the films illustrating predator-prey relationships	2.11 (13, 21, 23) Showing one of the films, "Food Getting Among Animals," "Nature's Half Acre," or "The Wood Duck's World" would help demonstrate predator-prey relationships. Information about these films can be found in Appendix A. Emphasize that in a predator-prey relationship one organism benefits while another organism loses completely. Could the interaction help both populations?
*2.12 Define and discuss parasite-host relationships	2.12 (13, 21, 23) Ask questions such as how does the relationship between the flea and dog differ from the relationship between the snake and mouse? Introduce the terms parasite (flea) and host (dog). Can the students think of other parasite-host relationships? Parasites can be internal (tapeworms) or external (ticks). What happens when the host for an internal parasite dies? Do all parasites stay with the same host? (Only the internal parasite) How does a parasite differ from a predator? Which is more dependent on the host, an internal parasite or an external parasite?
2.13 View parasite life cycles	2.13 (13, 21, 23) Many parasites have complex life cycles; some examples are diagrammed in Appendix B. Questions are included to aid discussion of the life cycles. Discuss how we control parasites like mosquitoes, wheat rust, etc. (In most cases we deprive them of one of their needs.) Can the students think of parasites that have affected whole groups of people? (Malaria, hookworm in southern United States, and etc.) Parasites usually help control populations indirectly by weakening individuals so predators can kill them. At one time tapeworm eggs were sold as diet pills.
2.14 Have students do research on a selected parasite	2.14 (13, 21, 23) Have students select a parasite from the following page and determine what its host is, how it affects the host, where it is found, how it is controlled, and the problems the parsite has caused or is causing man.

2.14
Have students do research on a selected parasite (Continued)

2.14 (13, 21, 23)

aphids
ticks
mites
leech
malaria
lamprey
slugs
smut
louse
thrips
nematode
mosquito
webworm
tuberculosis
bracket fungi
wheat rust
codling moth
white grubs
trichina
screwworm
canker worms
ringworm
chinch bug
leaf miners
lace bugs
mistletoe
powdery mildew
downy mildew (potato blight)
amebic dysentery
filaria (elephantiasis)
blister beetle
red spider mite
tent caterpillar
witches' broom
trypanosoma (sleeping sickness)
trichinella spiralis (round worm)
athlete's foot
rickettsias
strangler fig

*2.15
Define and discuss the role of scavengers

2.15 (13, 21, 23)
Introduce the term scavenger. Scavengers are those animals that eat organisms that were killed by something other than themselves. Ask questions such as how is the relationship between the vulture and a dead cow different from the coyote and rabbit, or flea and dog?

Many animals are predators as well as scavengers, for example, hawks. Do the activities of scavengers affect the size of populations? Are the activities of scavengers important along our highways? How? Scavengers are often called the clean-up crew for nature.

*2.16
Define and discuss decomposers

2.16 (10, 11, 13, 17, 21, 23, 38)
Ask questions such as, what happens to food left out of the refrigerator for several days? (Decays, spoils, rots) What causes food to decay? (Mold, bacteria) What happens to a tree when it dies? What happens to animals when they die if scavengers do not eat them? Introduce the term decomposer. Decomposers can be either plants or animals. They break their food down so completely no useful energy remains and the matter is returned to soil. Most decomposers are microscopic like various types of bacteria; others like fungi, mold, and earthworms are easy to see. Decomposers are very important as they return matter (minerals) to the soil so plants can use it in making more food.

2.17
Observe decomposing
material

2.17 (17, 33)
Have the students observe and smell some decaying fruit or vegetables. Why is decomposing an important process? What would the world look like if there were no decomposers? (Consider the biological needs of decomposers) Emphasize that decomposers need oxygen, water and food as well as a suitable habitat. Does burying material in a landfill speed up or slow down decomposing? (This process is slower because less oxygen is available) Why do we put food in refrigerators? How do we kill the decomposers in canned food? Look at some food package labels, can you find anything included to kill or slow down decomposers? (Preservatives) What gives various flavors to cheese? (Mold) Many sprays used to stop odors work by killing the decomposers that produce the odor.

*2.18
Discuss Energy Path

2.18 (7, 9, 20)
Energy plants and animals use comes from the sun. Only plants containing chlorophyll have the ability to capture this energy so it can be passed on to consumers. This energy is stored in the form of food. When a person or any other animal eats food, they use only a very small percentage of the energy contained in the food. Most of the energy is lost as body heat. The useful part of the energy is used for moving muscles, thinking, circulating blood, etc. Energy cannot be reused. Once energy is used, it is lost into the atmosphere as heat.

An energy path is similar to a food chain except it starts with the sun and shows an energy loss each time food is consumed. After decomposers finish with their food, no usable energy remains. An example of an energy path could be: sun ——→ grass ⤳ grasshopper ⤳ snake ⤳ hawk ⤳ bacteria ⤳ . Another energy path is illustrated in Appendix B. (⤳ indicates energy loss)

*2.19
Defining the
Matter Cycle

2.19 (3, 4, 36, 37, 39)
Matter continues to cycle within the environment. A simple example is the oxygen-carbon dioxide cycle; plants use carbon dioxide and release oxygen while animals use oxygen and release carbon dioxide. Illustrate this with a simple diagram on the chalk board.

Food is a combination of matter and energy. Th energy is lost into the atmosphere as heat when food is eaten. The matter, or solid part of the food, is used to build animal bodies or is passed out of the body as waste. When any material decomposes, the energy it contains is released into the surroundings and becomes useless as far as plants and animals are concerned, but the matter (minerals, etc.) is returned to the soil in such a form that plants are able to use it in making more food. What

*2.19
Defining the
Matter Cycle
(Continued)

2.19 (3, 4, 36, 37, 39)
would happen to our soil if things did not decay?

Bring out the fact that part of the material in present-day plants and animals is composed of what was part of the bodies of plants and animals of prehistoric times. When they died they decomposed and the material was returned to soil for use by plants.

TEACHER NOTE: What effect does placing human bodies in vaults, to prevent decomposing, have on the matter cycle?

Illustration of the matter cycle as related to the food chain:

As food is passed along a food chain, only about 10 percent is actually used by the consumer, the remainder is returned to the soil as waste and is decomposed to re-enter the matter cycle. Much of the 90 percent that is waste, for example roots, is never eaten by the consumer. This material is immediately decomposed. This is an extremely important point to consider when talking about the world food supply. For example, let's consider a simple food chain and how this can affect the amount of food available to man. Algae ____ snails ____ small fish ____ larger fish ____ man. This could be a typical food chain in an ocean. For simplicity, let's assume man could live by eating only one type of food. In order to produce a 100-pound man, he would need to eat 1,000 pounds of large fish. Only 10 percent of the 1,000 pounds of large fish can be used to produce 100 pounds of man.

To produce our 1,000 pounds of large fish, the large fish would need to eat 10,000 pounds of small fish; again, only 10 percent of the food is used. To produce the 10,000 pounds of small fish, we would need 100,000 pounds of snails, and to produce 100,000 pounds of snails, we would need 1,000,000 pounds of algae. This should be included in the students' notebook:

Algae ____ snails ____ small fish ____ large fish ____ man.

1,000,000* 100,000 10,000 1,000 100

*pounds

Matter cycle and increased population:

In theory, if man would change his diet to small fish in this food chain, we could feed 10 times as many people. If man would eat snails, we could feed 100 times as many

***2.19**
Defining the Matter Cycle (Continued)

2.19 (3, 4, 36, 37, 39)
people on the same amount of algae. If man would eat the algae directly, we could feed 1,000 times as many people. In summary, what this illustrates is that the closer to the producer a consumer is, the greater the mass of that consumer. Hence, a large population can be supported. Think about some country, like China, which has a high population; what is their primary food source? Their food chain might be simply, rice → man. Could China feed as many people if they fed the rice to cows and then they ate beef? The total amount of food produced is not increased, since the world can only support a limited number of plants. Man has more food available because he controls the type of plants grown, and he can eliminate competition from other animals.

As the population of the United States increases, would you expect Americans to eat more corn and less beef and pork? How would this allow more people to exist without starving? What plant is man eating more of today than he did 10 years ago? (Soybeans) Farmers sell pigs when they weigh around 200 pounds. How many pounds of producers would the farmer need to raise 1,000 pigs during the year? (3,000,000)

Two illustrations, "A Matter Cycle" and "The Pyramid of Matter and Numbers," are included in Appendix B. These help illustrate the movement of matter through the food chain.

***2.20**
Discuss Competition

2.20 (13, 21)
Competition is when two or more organisms require the same food supply, space, etc. The competition can be between plants or animals of the same species or different species. Both man and insects eat wheat. This example of competition is one of great economic importance. Think about the problems brought about by the use of insecticides to control the competition. As the students read stories and watch films, have them watch for examples of competition. Can they find examples of competition within the food web formed by the class. (Two organisms eating the same organism?)

***2.21**
Discuss Adaptation

2.21 (23, 28)
Adaptation refers to the special features plants or animals have that help them live in their environments. What kind of teeth do grass eating animals have? What special features do animals that live in a tree have? Do plants that live in shade differ from those that live in full sunlight? Do animals that tend to be eaten have large numbers of offspring?

Appendix B contains illustrations showing bird feet and beak adaptations. Have the students decide how each foot or beak is adapted to function in a particular environment.

***2.21**
Discuss Adaptation
(Continued)

2.21 (23, 28)
The film, "Why Plants Grow Where They Do," see Appendix A, gives good examples of how plants have adapted to live in certain climates. Why do more plants and animals live in the warmer climates? What special adaptations do animals and plants living in a desert area, or other special climatic area, need in order to survive?

Collect several pictures of plants and animals and have the students describe how they are adapted to live in their special environment. Match the pictures with the climate in which they can live.

After the various concepts and relationships existing within a food web have been introduced, students will need more contact with each idea before it will be meaningful to them. To assist teachers in relating the various terms (producers, consumers, predators, etc.) with each other, an organism organization chart is provided in Appendix E.

2.22
Reading and interpreting food webs using pictures

2.22 (10, 12 - 18)
After reading the short stories, (see Appendix D), the students can arrange the pictures to show food chains or food webs.

Each student will need a set of the plant and animal pictures and food web stories found in Appendix C. Cut the sheets so each picture is separated. As students need other pictures, they can sketch their own or cut pictures from magazines. If they will work on a table top, or their desk top, and not glue or otherwise fasten down the pictures, they can be used many times for other stories. Have the students find stories to illustrate using the pictures.

Some teachers have found the pictures can be used to make up card games, like Rummy. The pictures can be placed in groups like predators, producers, scavengers, decomposers, etc. Have the students develop some games using the pictures that illustrate the various concepts.

2.23
Read short articles illustrating various food web concepts

2.23 (12 - 18, 33, 40, 42)
Several articles are included in the Appendix D. Each of the articles illustrates one or more concepts relating to food webs. A set of suggested questions accompany each article. These can be used as either classroom, small group, or individual exercises. Classroom quantities of each of these articles will be available for use on a check-out basis.

TOPIC III: OBSERVATIONAL SKILLS

3.0
Introduction

3.0
Only after a student interacts or becomes involved with various facets of his environment will he develop any realistic understanding of nature's complex structure. For example, after students interact with a woodland they will see a forest as a complex group of interacting systems rather than just a group of trees. Development and utilization of the senses is the only way we can have successful interaction or involvement. Activities designed to increase the effective use of all the senses will assist in understanding our environment. As an aid for developing observation skills, the National Park Service has developed the strand approach. The strand approach consists of five strands, or broad guidelines, one can use to direct observation.

The strands are:

1. Variety and Similarities
2. Patterns
3. Interaction
4. Change
5. Adaptation

Introduce the students to the strand terms (see Activity 3.1). Briefly discuss each one, having the students find illustrations of each in the classroom. After they are able to find examples in the classroom, have the students locate examples in the school yard. You may wish to cover only one "strand" during a session.

The strand concepts are usable in all subject areas. In Appendix E you will find suggestions of ways each strand can be applied to various areas of education. Using the strands will improve observational ability and interest.

Have the students include the strand definitions and activities in their notebooks.

*3.1
Discuss and view illustrations of variety

3.1 (21, 22, 23, 24)
Through variety we can view the variations, or differences, existing in nature. For example: How is a tree different from grass? How is the north side of a pond different from the south? What variation can be found in two leaves from the same tree?

*3.1
Discuss and view illustrations of variety
(Continued)

3.1 (21, 22, 23, 24)

Similarities direct our observation to those commonalties that exist in nature. What do trees and grass have in common? How are soil and water alike? What plants exist on both the north and south sides of a pond? What do all of the leaves from the same tree have in common?

Patterns allow us to observe nature's organization. What repeated arrangement is found in the branches of a tree? What in repeated in a blade of grass? What is the shape or form of a wave? What vegetative arrangement exists under trees?

Interaction directs our attention to how one organism, or part of the environment, affects the surrounding organisms, simply by its existence. What happens when waves reach the shore? What happens when a tree shades the ground? What happens when a seed sprouts? What happens when a tree dies? What happens when it rains? Can one organism exist alone?

Change is the most easily recognized, for everything is in some state of change (chemical, physical, or biological). Yet change is hard to observe because it takes time. The results of the change are observable. What happens when a tree ages? How are you different today than yesterday? Do all things change at the same rate?

Adaptation is nature's way of selecting the most fitted organism for a particular environment. Only those organisms that are able to adapt to their environment live to reproduce their species. Why do trees die when surrounded with water? Why don't fish live on land? Can you find moss in bright sunlight? How are water plants different from land plants?

Following are observational activities designed to increase the use of the senses and the strand concepts.

*3.2
Observe the school yard environment using the student observation sheet as a guide

3.2 (15, 16, 17, 26, 22, 23, 24)

Most people use the sense of sight almost exclusively. We also have a tendency to view only the large or obvious. We can all become better observers by looking for more detail and by taking advantage of all our senses.

Take a short trip around the school block or a nearby block. Stop several times and have the students sit down and carefully observe plants, activities, etc. Although the main emphasis can be on using the sense of sight, take advantage of the opportunities to use all the senses. Closing your eyes may help.

*3.2
Observe the school yard environment using the student observation sheet as a guide
(Continued)

3.2 (15, 16, 17, 26, 22, 23, 24)
A student observation sheet, located in Appendix C, will help guide student observation during the trip. Put special emphasis on observing the little or minor sights, sounds, smells, etc.

*3.3
Experiment with the sense of touch

3.3 (21, 22, 23, 24)
By eliminating the use of the sense of sight, a student will become much more aware of observations using the sense of touch.

The students will need to work in pairs, one as a recorder, the other as the experimenter. Have available, a wide assortment of objects, including many natural things like rocks, leaves, twigs, worms, etc., as well as man-made objects. The experimenter closes his eyes while the recorder selects an object and hands it to the experimenter. The experimenter should have his hands behind his back, thus eliminating the need for a blindfold. The recorder lists all the words used by the experimenter to describe the object. Reverse the roles and repeat.

What effect did using only the sense of feel have on your ability to describe an object? Could a stranger tell what object was being described?

Repeat the feeling exercise after the class has discussed various adjectives one can use to describe the way objects feel. Can we feel with any part of our body besides our fingers?

List the adjectives used in the various descriptions on the chalkboard. Add the less familiar words to the student notebooks. Use a Thesaurus or dictionary to find new words to describe the way objects feel. Does the object vary in its surface texture? Can they describe any patterns on its surface? What type of student reaction does feeling an object cause?

3.4
Use a blind walk to increase one's use of the sense of touch

3.4 (21, 22, 23, 24)
A guide is to teach the observer, through the sense of touch, about areas and objects.

Have students work in pairs where one serves as a guide and the other student is the observer. The observer will either keep his eyes closed or wear a blindfold. The guide cannot speak to the observer, but must give directions by touching or leading

3.4
Use a blind walk to increase one's use of the sense of touch
(Continued)

3.4 (21, 22, 23, 24)
the person. For example, guide the person through a ditch by holding his arm or touching his shoulder. The observer must trust the guide and the guide must be careful not to let the observer fall. The guide could teach the observer about a bush by guiding his hands to the various parts. The observer will get a new view of his world. Think about the blind man and the elephant. Allow the students time to discuss their experience. Did the students develop a special closeness?

*3.5
Experimenting with the sense of taste

3.5 (21, 22)
We can learn much by using our sense of taste, but never taste anything unless either you or someone with knowledge about the material knows it is safe.

Use the same procedure as for working with the sense of touch, in pairs and with eyes closed. Have available several edible items like small pieces of carrot, lettuce, orange, lemon, flour, salt, sugar, etc. Place the material to be tasted on a sheet of paper or in a small cup, hand it to the experimenter and have him place it in his mouth.

The follow-up discussion should be similar to that used for the sense of touch.

If students would like to know more about taste, help them locate reference books from which they can find out what type of taste buds are on the tongue and where they are located. References are available concerning "safe" things in nature to eat and/or taste.

*3.6
Experimenting with the sense of smell

3.6 (21, 22)
Use the same procedure and follow-up as with the sense of touch and taste. Have available several containers with various smells; for example, clay, a variety of spices, fragrant flowers, common foods, rich soil, etc. could be used. The recorder can hold the material just below the experimenter's nose. Have students discuss the smells they like and dislike giving their reasons for their judgment.

*3.7
Observing with the sense of hearing

3.7 (21, 22, 23, 24)
We hear sounds constantly, but seldom do we try to describe any one sound. The sound observation sheet, Appendix C, will help students describe some of the sounds they hear. Have each student take his pencil and observation sheet and spread out over the school yard with at least 10 feet between students. Listen and record observations for about 10 minutes. Follow this with a discussion centered on how to describe sounds.

3.8
Write a story about a tree

3.8 (10, 21, 23, 24)
By combining imagination with observations, students can develop greater insight into the natural environment.

Have each student select a tree they especially like. It could be near their home, at school, in the park, or some other place. After they carefully observe their tree, each student can assume they are the tree and they can write the tree's autobiography. They can consider, (1) how the tree got to its present location, (2) how many years it has been alive, (3) what animals live in its branches or use the limbs, (4) signs of damage from storms, people, and insects, (5) its neighbors, (6) how long it will live, (7) the changes that have occurred around it during its lifetime, (8) changes in its bark with time, and (9) its changes with the seasons.

3.9
Increase observation and the use of adjectives through property bingo

3.9 (22, 23, 24)
The intent of this activity is to increase students' awareness of their surroundings through the use of adjectives.

Each student will need a sheet divided into 25 squares as illustrated in Appendix C (property bingo). If the sample words are not appropriate, choose adjectives that are suitable for your area and students. Send the students onto the school yard with their bingo sheets. Instruct them to write the name of an article below the adjective within the space it illustrates. Students may also bring articles into the room. You must be careful about destroying the school ground if they collect items.

You can make up appropriate rules for playing property bingo. One way to select a winner is to determine who has completed the most squares that form a straight line containing five items. You will need to set rules, such as whether any item can be used for more than one adjective and whether they can use only natural or both natural and man-made items.

Discuss where students found their items. Were more items dead or alive? How many items were man-made? How many were trash? Were any items animals? Did anyone find an item that illustrated two or more of the adjectives?

*3.10
Students become aware of the amount of life that can exist in a small space by doing a quadrat study

3.10 (10, 21, 22, 23, 24, 27, 28, 29)
Students will carefully observe a small area to determine the plant and animal life present.

This activity can be done in either the school yard or a nearby park. Its value is greatly increased by repeating it in a contrasting area or in a different season in the same area. Do not be concerned with plant or animal names. Students can make up names based on shape, size, etc. Have the students work in two's or three's and use the quadrat study recording sheet in Appendix C as a guide. If hand lens are available, they will be hlepful. After viewing the plants and animals on the surface, have the students carefully dig among the plant roots, etc.

Each group will need a piece of string about eight feet long. When the ends are tied together, it will form a two foot by two foot square. The string helps confine their attention to a small area. Go over the recording sheet with the students before they go out. Suggest they record plants and animals similar to the examples on the sheet.

3.11
View the film, "What Ecologists Do"

3.11 (21, 22, 23, 24, 40, 42)
The film, "What Ecologists Do," listed in Appendix A will help the students relate their data collecting experience to that used by research scientists when studying a natural area. Use the questions provided in the film summary sheet to help direct discussion.

*3.12
Observe the detailed structure of plants and animals

3.12 (21, 22, 23, 24)
This activity will give students an opportunity to observe closely the structure of some plants and animals.

Collect a number of plants and animals equal, or greater than, the number of students. The following organisms could be used: plants without roots, grasshopper, geranium, beetle, earthworm, duckweed, fly, lizard, spider, grass, tomato, grass with roots showing, hamster, fern, moss, algae, mold, onion set, frog. The organisms used will vary with the season, but try to have a variety.

Arrange the organisms around the room or in small groups with names attached in such a way that the students can easily move in a line from one organism or group to the next. Decide if you want the students to observe only with their eyes or to also smell and touch the organisms. Go over the observation charts with the students and explain ways to describe each characteristic. Try to use single words. For example, the stem could be: round, rough, square, fuzzy, or shiny. If a characteristic does not fit the organism, leave that space blank. Start by assigning each student, or pair, to an

*3.12
Observe the detailed structure of plants and animals (Continued)

3.12 (21, 22, 23, 24)
organism. Have then observe it for two minutes, then have all students rotate to the next organism. If you prefer, organisms can be in groups on desks or tables and students can work in groups. They can record their observations on the plant or animal observation charts. (Charts are shown in Appendix C.)

3.13
Discussing student observations

3.13 (21, 22, 23, 24)
Following the observations, spend time discussing careful observation of each organism. During the observation, many students will "infer" as well as observe. Bring out the difference by showing a plant from which you have removed the roots or some other characteristics they were inferring about.

Another good way to demonstrate the difference between observing and inferring is to hold up a small toy car on a pan of light brown sugar, and ask for a description (car on sand). Point out that T.V. commercials used to use this technique often, but they are slowly being stopped through regulations of the F.C.C. (Federal Communications Commission).

Suggested questions: Was the flower stem round or square? Can they find variation and similarity between organisms? Can they infer what type of habitat each organism could live in? Can they construct a food chain using the organisms? Did you really see four legs on the hamster?

3.14
Studying Adaptations through the use of toothpicks

3.14 (23)
This activity will illustrate one type of adaptation, protective coloration. Have a set of colored toothpicks (5 each, red, orange, white, green, and blue) for each four students. These can be made by dyeing wooden toothpicks with food coloring. Students in groups of four should stand in an eight foot circle (outdoors) facing outward. Scatter one set of toothpicks inside each circle. Have the students turn around and start collecting the toothpicks. Each person should keep a record of the order in which they find the toothpicks.

Which colors were picked up first? Which color was the hardest to find? If you were a worm, which color would you rather be? If you were a bird, which color of worm would you most likely find first? Would the toothpicks be found in the same order if you were in a different area? Why? Have the students find pictures illustrating protective coloration in animals.

3.15
Collecting data for developing the concept of variation and similarity through the use of a personal data sheet

3.15 (22)
Students seldom have an opportunity to collect and work with original data. This activity will enable the students to collect raw data, combine the data, and draw conclusions regarding similarity and variation within the human species. Skills in measuring, graphing, and analyzing information will be developed or reinforced. Any population can be used to illustrate the variation and similarity that exist within nature. By using data derived from the student's bodies, they will better understand not only variation and similarity, but also more about themselves.

You may wish to modify this activity if you have a student with an embarrassing physical feature, such as very small or very large feet. You could easily leave out data collecting for that trait.

You will need the following material or equipment: one personal data sheet (Appendix C) per student, bathroom scales for measuring weight, scale on wall for measuring height, scale on the wall for measuring eye level, foot rulers for measuring finger length and hand span, scale on wall for measuring total arm's length, scale on floor for measuring pace, scale on wall for measuring reach, and a mirror.

Have a few selected students make the various scales on stiff paper or cardboard. Measuring to the nearest inch will be sufficient, except for finger length and hand span.

Either have the students working in pairs helping each other take and record measurements, or assign a student to be responsible for each of the stations located throughout the room. Number the stations to correspond to the personal data sheet.

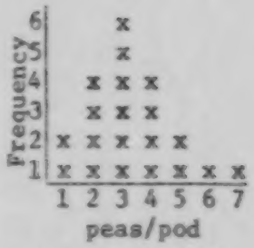
The data collected will be used in constructing a histogram in the next activity.

3.16
Construct histograms (graphs) illustrating variation and similarity with the data from the personal data sheets

3.16 (22, 23)
A histogram is a graph showing the frequency of any one characteristic in a population. For example, a histogram illustrating the number of seeds per pea pod, in 20 pods, might look like this:

3.16
Construct histograms (graphs) illustrating variation and similarity within the data from the personal data sheets (Continued)

3.16 (22, 23)



Based on the histogram, we can see there is a variation between one and six peas per pod. Most of the pods have two to four peas per pod; this shows similarity.

You will need scissors and graph paper for each student. Have each student cut his data sheet from the previous activity (3.15) in strips so each measurement is on a separate strip. Group all data for one measurement. For example, collect all height measurements together.

Assign each type of measurement to student groups of two or three. Each student in the group should have one page of graph paper (Appendix C) on which he can compile the data. If your students have not worked with graphing of this type, you may wish to do one set using a graph drawn on the board.

The students should first place frequency numbers up the left side of their graph with the first space (not line) being number one, and continue counting to the top. Label the base of their graph with the characteristic, such as height, etc. Determine appropriate numbers for the base of the histogram and label the spaces. Next, place the number of x's above each characteristic showing the frequency of its occurrence.

After graphing the data, the following questions should help the understanding of variation and similarity. What shape does most of the graph follow?

What would you call the average (the most common measurement) for each graph? If I say, "The average sixth grader is _____ inches tall," would it be true? This is an example of similarity--all things of one kind have much in common, although there is variation. If I say, "Most sixth graders are between _____ inches and _____ inches tall," would it be true? This is an example of variation--all people, animals, and plants are a little different from each other. These values can be discussed in terms of range and mean.

3.16 Construct histograms (graphs) illustrating variation and similarity within the data from the personal data sheets (Continued)	3.16 (22, 23) After each group explains to the remainder of the class the variations and similarities illustrated by their graph, display the graphs for viewing by others. They can record sketches of each graph in their notebooks. Be sure to indicate the range and mean values on their sketches. At this point, one can bring out how variation allows some organisms to adapt to certain types of environmental conditions better than others. For instance, if one is selecting a basketball player, which height would most likely be chosen? If one is selecting a person to run a mile, what type of pace would you want him to have? What finger length would be best for typing? Why do airlines limit weight and height of their stewardesses? The idea of adaptation can then be extended to wildlife such as rabbits. For example: rabbits that are able to run faster are more likely to survive because they can escape more predators. Why do some species of animals live only in certain countries? Discuss how plants and animals adapt to different climatic conditions.
3.17 Observe natural patterns	3.17 (22, 24) All the world has some type of organization. Once students become aware of patterns, or the natural organization that exists, they will be much better observers. The pattern formed by the veins in leaves is easily observed. If you have leaves brought to the classroom, be sure the students realize that they should not pick very many from any one tree or bush. Pencil or crayon prints can be easily made. The students could make a collection of their prints and then compare the patterns for variations and similarities.
3.18 Establish and observe change jars	3.18 (21, 22, 24) Many changes are occurring in nature all the time, some are very fast (earthquakes) while others require long periods (ocean formations). One way changes can become more real to the students is for them to establish and observe a change jar. Each student will need something like a baby food jar. They can put anything they choose in the jar, the greater the variety, the better. Place the jars where they can be easily observed for several weeks. Each student should record the changes he notices, if any occur. Many excellent things for discussion will develop. Why does the one with the rock not change? What caused the smell in the one with bread and water? What is alive in the one that had only water in it? Did anything grow that was not planted?

*3.19 Establish plants and animals in the classroom	3.19 (21, 22, 23, 24) Few students have carefully observed a single plant or animal over any length of time. By having plants and animals in the classroom, you can direct students' attention toward the organisms' needs, interactions with their environment, changes, various habits and characteristics. In Appendix E you will find simple directions for establishing and caring for several types of organisms. Most wild animals should be brought in for only short periods, if at all, before being released. They have special food and habitat requirements that are hard, or impossible to meet in the classroom environment.
*3.20 Discuss changes as illustrated by populations	3.20 (10, 21, 23, 24, 25, 26, 42) Natural populations are affected by many biotic (living) and abiotic (non-living) factors causing them to fluctuate during a period of time. You can use the population cycle graph and the factors controlling population diagram, Appendix B, to illustrate the controlling influences on a population. Long lasting population changes result when the decreasing (disease, predation, competition, unfavorable climatic conditions, etc.) or increasing (space, ideal weather, full food supply, protection, etc.) factors are changed from the normal balance. Over-population or extinction is the end result of a badly disturbed balance. The students should record in their notebooks a list of factors causing population changes indicating which of the factors cause increases and which cause decreases.
3.21 Constuct population graphs illustrating environmental factors effecting population size	3.21 (10, 21, 23, 24, 25, 26, 42) Students improve their understanding of graphs after they have constructed their own. See Appendix E for data of four different populations, and samples of completed graphs for each population. Using this data, and the graph paper (Appendix C), students can construct the four graphs. You may wish to provide them with numbers for use on their graphs.
3.22 Discuss the snowshoe hare graph as an illustration of a population in balance with nature	3.22 (21, 24, 26, 32) Graphing the data of the snowshoe hare, Appendix E, will illustrate the natural fluctuation for a balanced population. Emphasize that a balanced population does not remain constant but is constantly increasing and decreasing. After graphing the data, discuss factors causing the variation in numbers. Keep in mind the lynx is a common predator of the hare and its population fluctuates with the hare's. Changing weather patterns, space, and disease also play a part in population changes. How many years lapse between peak population counts?

3.22 Discuss the snowshoe hare graph as an illustration of a population in balance with nature (Continued)	3.22 (21, 24, 26, 32) The article, "The Wolves of Isle Royale," Appendix D, is an excellent article on natural control of population numbers and correlates well with the snowshoe hare graph.
3.23 Discuss the ring-neck pheasant population graph as an example of a population in a favorable environment	3.23 (21, 24, 25, 27, 40) The data for ring-neck pheasants, Appendix E, will illustrate seasonal influence on population in a favorable environment. The spring counts were made before eggs were hatched so the decrease was due to birds dying during the winter. Have students consider the possible causes of the decrease in the population during the winter. It is interesting to note that the winter loss in a game bird population is used to help determine the bag limit for sports hunters. A number of birds will die due to starvation and other factors during the winter. The birds collected during hunting season mostly come from populations that would have died during the winter. The diagram, Carrying Capacity of Habitats, Appendix B, could be used to bring this out. Point out that the pheasant population would not increase forever but would reach the carrying capacity of the island and then level off showing only seasonal variation.
3.24 Discuss the U. S. population graph as an example of the changing rate of increase	3.24 (21, 24, 25, 33, 40) The graph of the U. S. Population, Appendix E, shows the changing rate of increase in the number of people. The current rate of increase of about one percent will cause our population to double in 72 years. During the first hundred or so years, were all people in the U. S. counted? What about the Indians and the slaves? When are the people of the U. S. counted? How? Discuss how the U. S. has been able to support the present rapid increase. Can we continue to support this kind of increase? Consider food needs, space needs, use of raw materials, and change in social patterns.

3.25 Calculate the density of the United States	3.25 (22, 24) Using 330,000 square miles as the land size of the U. S. in 1770, calculate the density (people per square mile) in 1770. Find the present size of the U. S. and calculate the current density. Along with this, consider the land that is not suitable for either food production or living space. We do not have any more land available for expansion. Illustrate the effect of no more land being available by having a student stand in an eight foot circle drawn on the floor. Gradually increase the number of students in the circle. How do they react to the crowding?
3.26 Discuss the Kansas population graph as an example of how environmental factors affect population size.	3.26 (21, 24, 25, 27, 33, 35, 40, 42) Some interesting points can be developed by graphing the Kansas population because the number scale is much smaller, thus showing more detail. Why did the Kansas graph start with 1360? (No previous census) Why the drop in population during 1940? (Dust bowl of 30's) Why the level area in late 1800's? (Dry years) Using the area of 32,048 square miles as the area of Kansas, have the students calculate the density for 1360 and 1960. How would our lives be different if we were evenly distributed over the land instead of being in cities? Project the population for 2060. How have life styles changed as a result of this density change?

TOPIC IV: FIELD TRIP

4.0 Introduction

4.0

The field trip experience should: 1) bring realism to the ideas and concepts discussed in the pre-trip portion of the unit, 2) give the student an opportunity to use all his senses in the study of the environment, 3) provide each student with an opportunity to collect data about natural areas, 4) stimulate interest for further study about environmental problems, and 5) help each student formulate his own environmental ethic.

To get maximum benefit from the field trip experience, students need to be properly prepared academically as well as psychologically for the day's activities. Academically, they should have experienced the starred activities of Topic I, The Basic Needs of Plants and Animals; Topic II, The Food Web; and Topic III, Observational Skills. Psychologically, they need to understand the purpose for the field trip is to study a portion of their environment. The trip is not just a day in the woods. However, it will also be fun! They also need to understand what activities they will be involved in during the day.

In addition to the above preparation for the field trip, the classroom teacher will need to:

1) Select a date for the field trip that is mutually acceptable to the teacher and project staff.

2) Have the field trip date approved by the building administrator.

3) Send a letter to the students' parents notifying them about the trip. (Sample letters are included in Appendix F) Select the one requiring parent signature only if the principal requests parent signatures.

4) Make each student two copies of the data sheet for use on the field trip.

5) Be familiar with the field trip follow-up activities.

6) Be prepared to either assist or lead a small group (about ten) of students during the field trip. Study the leader directions in Appendix F.

7) Divide the students into six groups (if your class will be going with another class, otherwise divide into three groups). Have a list of names for each group.

8) Have each student either bring a pill bottle for collecting a water sample containing micro-organisms, or bring a larger container for a classroom sample.

9) Collect ten cents from each student if your class will be stopping for cider slushes on the way back. This is up to the teacher.

10) Convey the following information to the students:

A) Dress

Each student should "layer" dress so as the day warms he can remove a sweater or light jacket. This will help prevent the person from being too warm or too cold. He should wear hard-soled shoes to prevent thorns from puncturing his feet. Do not wear shorts, even on hot days.

B) Equipment

1. Students should bring a pencil or ballpoint pen for use during the field trip. Place it inside their lunch sacks as it is not needed until afternoon.

2. Clipboards, thermometers, hand lens, and a compass will be furnished for students during the field trip.

C) Bus Ride

1. Students are to remain seated anytime the bus is moving.

2. No heads or arms are to be extended out the windows.

3. Probably, there will be three students to a seat.

4. Nothing is to be thrown out the bus window.

5. Loud talking is not acceptable while on the bus.

6. Singing is encouraged

D) Lunch

1. Each student is to bring a sack lunch - do not bring any glass containers.

2. Have students put their names on their lunch sacks.

3. Drinking water will be provided.

4. Disposal containers will be available in the site area.

E) Restrooms

1. Restroom facilities are available in the site area.

2. Have students use the restroom before getting on the bus.

F) Name Tags

Each student is to write his name on a piece of masking tape. Print this large enough so it can be easily read. Attach on the upper left side of wearing apparel.

Normally, two classrooms will be combined for field trips.

The following is a brief overview of the field trip activities. Copies of the student handouts, field trip schedule, and other material referred to are included in Appendix F.

*4.1
River Road Sites

4.1 (21, 22, 23, 24, 34, 35, 40, 41, 42)
Traveling to Perry Reservoir will be by way of the River Road (South side of the Kansas River). Students will remain on the bus, but there will be several brief stops to discuss the locations listed on the River Road Sites Sheets, Appendix F. Students will be given copies of the River Road Sites Sheets for use on the way to Perry. As a result of the various site discussions, the students will gain a better

*4.1
River Road Sites
(Continued)

4.1 (21, 22, 23, 24, 34, 35, 40, 41, 42)
picture of how people, industry, farming, and nature interact with each other. The article, "Lecompton History," Appendix F, can be used in a classroom discussion following the field trip or as preparation for the trip.

*4.2
Morning Observation Session

4.2 (9 - 11, 14 - 18, 21 - 24, 27, 28, 30, 31, 34, 35, 40)
Upon arrival at the site, students will be provided drinking water and use of restrooms. The remainder of the morning will be spent in small groups, with the group leaders directing student learning through use of the senses, the strand concepts, plant and animal needs and observations, and environmental conditions in the site area.

Each student will have a hand lens for his use during this session. A Field Trip Guide briefly outlining sample activities to be performed during the day is included in Appendix F. More detailed suggestions are found in the aids for Group Leaders found in Appendix F. No one group will be able to experience all the suggested observations and many observations will be possible other than those listed.

*4.3
Habitat Studies

4.3 (9 -13, 21, 22, 23, 24, 27 - 35, 38, 39, 40, 42)
During the afternoon session, students will work in the same groups. Each student will be provided a thermometer, clipboard, and compass. They will also need their ballpoint pen or pencil, the water sample bottle, and the data sheets provided by the classroom teacher (two for each student).

Depending on time available and the part of the site being used, the students will study at least three of the following areas: woodland, grassland, pond, stream, and lake shore.

Each group will follow a different trail designed to lead the group to various types of areas. A sample trail guide is found in Appendix F. Only two data sheets will be completed. The area for their completion will be determined by the group leader. Trails will be developed and modified by the group leaders to best utilize the organisms available and to prevent paths from being developed. The trail directions will be given verbally to the students. Water samples can be collected at either the pond, lake shore, and stream for use in the classroom.

The method used for completing the data sheets will vary with student groups. Some groups will want to use checks in the blanks, while others will use words like some,

*4.3
Habitat Studies
(Continued)

4.3 (9 - 18, 21, 22, 23, 24, 27 - 35, 38 39, 40, 42)
few, many, etc. The data sheets should be collected at the end of the session so they will be available for classroom discussions.

As a final activity, each group leader should quickly review the day's activities with the students using the Final Field Trip Activity Guide (Appendix F).

4.4
Return Trip

4.4
Most classes enjoy singing during the ride back to Topeka. This can be a very enjoyable experience if they have prepared songs.

Groups who collected money for cider slushes will stop at Rees Apple Orchard.

Be sure to loosen the caps on the water samples as soon as you arrive back in the classroom, otherwise many of the organisms will die.

Following the field trip, students should be provided with an opportunity to discuss their reactions to the experience, view the microorganisms in their water samples, study the data collected, and study Topic V; Environmental Changes: Natural and Man Influenced.

*4.5
Observing Micro-
organisms in the
water samples

4.5 (21, 22, 23, 24, 42)
Using the microprojector, observe the microorganisms. Discuss how they are similar, how they are different, and how they move. Be sure to clean dust from the lens of the microprojector and slides to be used. Most microorganisms tend to settle to the bottom of an undisturbed container. To obtain the richest drop of water, use a drop from the bottom of the bottle.

The students often enjoy sketching several of the microorganisms they observe. They could make posters showing what they see in the water drops.

Once the students learn to operate the microprojector, leave it in a location where they can use it before and after school. Some organisms will remain alive several days if the lids are not tight on the containers.

***4.6**
Field Trip
Discussion

4.6 (all objectives of activities 4.1, 4.2, and 4.3)
One way to stimulate discussion about the various observations the students made while on the field trip, is to use word games. Take a word like ENVIRONMENT and have them name something they observed or experienced that starts with each letter of the word. For example:

E - enjoyment
N - nature
V - vegetation
I - insects
R - rain
O - omnivores
N - nymph of insect
M - man's trash
E - eggs
N - nuts
T - thorns

Other words that could be used: ecology, nature, bus, etc.

***4.7**
Transfer the data
from data sheets
to habitat
comparison sheets

4.7 (22, 23)
Completing the data sheets while in the field greatly increases the students' observation, but unless they compare the data collected from various areas, it is possible they will not develop a good picture of how the areas differ. Have the students sketch pictures of each area based on the information they obtained. Another good way to guide the students' attention to the similarities and variations between the areas is to transfer their information onto a Habitat Studies Comparison Sheet similar to the one included in Appendix F.

Do not suggest the data collected by a student be changed to conform to other's data or preconceived ideas. Data is good only as long as it represents the measurements and observations of the collector. Remember, there is variation in the way people view their surroundings. Students can use single words or phrases during the transfer. This will cause the student to analyze his data in order to put it into fewer words and will facilitate the comparison between the areas. Allow plenty of time for compiling the information.

After students have transferred the information onto one sheet, ask questions and lead a discussion to direct the analysis of the data.

4.8
Discuss and compare the various habitats

4.8 (15 - 19, 21 - 24, 28, 39, 40, 42)
Suggested Questions:

1) Which water has the higher temperature--pond or lake? Why?

2) Which appears to have the greatest amount of plant life--pond or lake?

3) What type of plants are found in the water?

4) Is the temperature difference greatest between soil and air or water and air? Will this always be true?

5) What type of plants were growing in the shaded areas?

6) Is there any difference in the plants found in the pond and those found along the lake shoreline?

7) What plants are associated with the hillside?

8) What type of plants are found in a grassland?

9) Does the direction of the slope influence the type of organisms found?

10) In which area did you feel most comfortable? Why?

11) Which habitat had the greatest amount of decaying material covering the soil?

12) Which area showed the greatest amount of erosion?

13) What area has the greatest influence on the pond? (Probably the hillsides, as minerals from the soil wash into the pond causing greater algae growth.)

14) How does the total area affect the lake?

15) What habitat contained the most observed animals?

Summarize this material with an understanding that each area has a slightly different plant and animal community with much interaction between the areas. Review the producers, consumers, and decomposers for each area and develop appropriate food webs.

TOPIC V: ENVIRONMENTAL CHANGES: NATURAL AND MAN INFLUENCED

5.0 Introduction	5.0 The material in topic five will help students understand man's role in the environment and how he affects it. Emphasis should be placed on how man changes the environment without fully understanding the long range effects of the changes.
*5.1 View one of the films illustrating natural succession	5.1 (21, 24, 27, 33, 34, 40) To illustrate how natural changes occur, view one of the films, "Succession: Sand Dunes to Forest," or "Plant and Animal Communities: Ecological Succession". These films are summarized in Appendix A. Emphasize that the changes or succession illustrated would occur even if man was not present. Man's presence only changes the rate, or modifies the direction, of the change.
*5.2 View and discuss examples of succession where man has altered the rate of change	5.2 (21, 24, 40, 41, 42) When discussing what affect man has on the environment, we first must realize that any area of the world is constantly undergoing changes even without man's presence. This constant change is called succession. (Include as a new word in the student notebooks) Pollution of various types alters the natural rate of change. Change or succession is a natural part of the environment. Man's use of the environment changes the rate and direction of that change. To illustrate natural change and man's influence on that change, you can discuss the life cycle of a lake. The film, "Lakes: Aging and Pollution," will provide an excellent introduction, and shows man caused changes. This can be supplemented with the pond succession diagram (Appendix B) and the article, "The Life and Death of a Lake," (Appendix D) which emphasize the natural changes and the influence man has had on these changes. Additional examples of how man alters the direction and rate of change are found in the following: Films - Appendix A 1. Survival of the Kit Fox 2. The Life Story of the Grasshopper

*5.2
View and discuss examples of succession where man has altered the rate of change
(Continued)

5.2 (21, 24, 40, 41, 42)
Diagrams - Appendix B

1. U. S. Virgin Forest Change Over 100 Years

Short Stories - Appendix D

1. When Animals Turn Invaders
2. New Central American Canal - Threat to Life
3. Sticking Our Necks Out
4. Wolves of Isle Royale

Emphasize the reason man caused the change. Did man intentionally cause most of the changes? What type of relationships have been disturbed? Does there appear to be more consideration given today to how man's behavior might influence the environment?

Many Americans believed strongly in a frontier or pioneer philosophy that nature's supplies were endless and they were here for man to exploit as he wanted. Has this changed?

*5.3
Examine and discuss how man is using and influencing the local environment

5.3 (21, 23, 24, 40, 41, 42)
The following discussion questions will help students understand some of the ways man's actions are influenced by the environment and ways man is using and modifying his environment.

1. How many different means of transportation do the students use in getting to school? Which of these ways cause the greatest influence on the environment? Does the distance (number of blocks) one lives from school affect the type of transportation he uses?

2. How much of your community is covered with non-living material like houses, pavement, etc.? What affect does this type of non-living material have on the number of producers present? Are any of the producers found in your block a part of your food chain? Where do most of the producers of your food chains grow?

*5.3 Examine and discuss how man is using and influencing the local environment (Continued)	5.3 (21, 23, 24, 40, 41, 42) 3. What type of material was used in the construction of the older buildings in your community? Are the same materials being used in the new buildings? Can you name some natural materials used in construction? Can you name some construction materials that are man-made? Where did man get the material used in the older buildings? What building materials should man use? Why? 4. Do environmental conditions affect the locations of cities and towns? Why was Topeka located on the Kansas River? Does the available water supply affect the type of industry that locates in Topeka? When Topeka was founded, what type of jobs did most of the people have? How many people living in Topeka today are involved in producing food? How has the location of Topeka affected the water in the Kansas River? 5. What type of fuel is used to heat your home? What power source is used to run the motors around your home? Where does the fuel come from? Where does the power source come from? How does the type of fuel and power being used affect the environment? Could large cities operate without power sources like electricity? 6. What was the land on which your house stands used for before the houses were built? Were there trees growing in the area before it was developed? Was it used for food production? 7. What type of waste or garbage is produced at your home? Does most of it result from man-made or natural material? Are there any ways we can reuse some of this material? Describe some ways we could reduce the amount of waste material. What happens to the garbage after it leaves your home?
5.4 Students examine their local environment	5.4 (21 - 24, 33, 40, 41, 42) By using the following questions, students will better understand how man has modified the local environment. As students answer the questions, discuss how the environment has been changed to meet man's needs. Be careful not to criticize a child's home area. 1. How many blocks is it from home to school? (Could make a histogram) 2. Where is the grocery store located from your home? 3. Are the various types of stores close together or scattered?

5.4
Students examine
their local
environment
(Continued)

5.4 (21 - 24, 33, 40, 41, 42)

4. Are most of the buildings old or new?
5. How far to the nearest hospital?
6. Are the streets all paved?
7. Do the streets have holes?
8. How many churches are in the area?
9. Do most families have dogs or cats?
10. Are there children living in most homes?
11. Are there apartment buildings in the area?
12. Are business buildings mixed in with houses?
13. Do people tend to move in and out of the area? If so, why?
14. Do you know a policeman?
15. How far are you from a fire station?
16. How far are you from a park?
17. How big is the park?
18. Do you ever use the park?
19. Which developed first, the houses or shopping center?
20. Where does the rain that falls in your area drain to?
21. Where is the food you eat produced?
22. Do most of the houses have garages?

5.4
Students examine
their local
environment
(Continued)

5.4 (21 - 24, 33, 40, 41, 42)

23. Are the houses mostly one or two stories?

24. Are there: 1) young, 2) old, or 3) dead trees in your area?

25. Are there light poles in front or behind the houses?

26. Are there alleys?

27. Are any yards fenced?

28. Where does the garbage go and how does it leave your area?

29. How many empty houses in your area?

30. How many people live in your block? (Possible histogram)

31. How many houses in your block? (Calculate the people per house using questions 30 and 31.)

32. Does your area have problems with garbage, junk, or old junk cars?

33. What population changes have occurred in the last seven years?

34. Where do most of the adults in your area work?

35. Do you see many birds and squirrels in your area?

36. Where does your power (electricity and gas) come from?

37. Do you have a garden?

38. Do you think your neighborhood is noisy? If so, what kind of noise?

39. What colors are the houses in your block?

40. How many street lights are in your area?

41. Is there a sidewalk between home and school?

5.4
Students examine their local environment (Continued)

5.4 (21 - 24, 33, 40, 41, 42)

42. How many cars pass your home in one evening?

43. Are there any industrial odors common in your area?

44. If you were going to locate a business in your area, what kind and where would you locate it?

45. How would you like to see your block changed?

5.5
Discuss pollution caused by each family

5.5 (40)
When we talk about environmental problems, sometimes we do not realize that each one of us contributes to the total problem. Have each student look at the pollution related activities of his family. How many pounds of trash do they discard per week? How much water do they use per week? How much power (gas and electricity) do they use per week? How many miles was the family car driven per week? Each of these activities contribute to the total pollution problem. Discuss how each one contributes and how each family could reduce the total problem slightly by reducing their polluting activities. For example, if everyone would walk, or ride bicycles short distances, instead of driving, air pollution could be reduced several percent. Is air pollution a problem in our city? What is our city's most important environmental problem?

5.6
Paper collecting

5.6 (40)
For each ton of paper that is recycled, approximately seventeen trees are saved for other uses. Have the class sponsor a paper collection within the school building. Assign students to arrange with each classroom to collect their waste paper at the end of each day. Keep a record of how much paper (by weight) that each room uses. Don't overlook the paper towels in the restrooms. The paper can be taken to a recycling center. Several P-TA groups are willing to help transport the paper and will help sponsor community-wide paper drives. Contact the recycling plant to determine the types of paper they can recycle.

5.7
Aluminum collection

5.7 (40)
Aluminum cans and other types of aluminum metal can be collected and recycled through the Coors Distributing Plant. Not only does this save the natural resources needed to produce electricity and aluminum, but also helps solve our solid waste problem. Have a student do research on how aluminum is produced and what properties of aluminum make it so useful.

APPENDIX A

Film Summaries

The films found in this unit are located in the Topeka Public Schools Film Library. Have your media specialist obtain them for you. These films were selected because they were readily available and illustrated the desired concepts. Other films can be used with equal or better results. Before using any of the following films in the classroom, read the summaries provided. The brief reviews of the films will help you select those that are best suited for your method of presentation and your students. The words for discussion and questions provided in each summary are not intended to be a complete guide, but an aid for the teacher in directing students during viewing and discussion of films.

Before the students view the film, direct their attention toward the specific concepts or ideas you want them to gain, otherwise they tend to only watch a "movie." By stopping the film during the viewing, emphasis can be added to special concepts or examples. Another useful tool in showing short films is to show the complete film, have a discussion, then view the film a second time with everyone looking for those specific examples, concepts, or ideas that were discussed.

The supply of filmstrips available that could be useful supplements for the unit material are too numerous to list. Your media specialist has available a list of filmstrips located in each building. Filmstrips can be obtained from other buildings for your use. "The Ecological Crises" filmstrip kit has been purchased by the project and is available to all classrooms. The filmstrip titles are: 1) Population Statistics, 2) Population Trends, 3) Some Ecological Considerations, 4) Evolution and Extinctions, 5) Pesticides, and 6) Pollution.

Films Illustrating Food Productions

Green Plants and Sunlight A-3

Learning About Leaves A-4

Plants Make Food A-5

Film Illustrating Various Forms of Energy

Energy From The Sun A-6

Films Illustrating Interactions Between Organisms

Food Getting Among Animals A-7

The Wood Duck's World A-8

Nature's Half Acre A-9

Life Story of a Grasshopper A-10

Life In A Pond A-11

Pond Animals A-12

Secrets of the Ants and Insects World A-13

Survival of the Kit Fox A-14

World In A Marsh A-15

Films Illustrating Changes, Natural and Man Influenced

Succession From Sand Dunes to Forest A-17

Plant and Animal Communities: Ecological Succession A-18

Lakes: Aging and Pollution A-19

Films Illustrating Variation

Fungi A-20

Life in the Ocean A-21

Animal Tracks and Signs A-22

Films Illustrating Adaptation

Why Plants Grow Where They Do A-23

How Nature Protects Animals A-24

Film Illustrating Ways to Study the Environment

What Ecologists Do A-25

GREEN PLANTS AND SUNLIGHT

11 min. - color - EBE Corp.

This film does an excellent job of illustrating the process by which food is manufactured within green plants. A series of experiments are illustrated, some of which could be performed in a classroom. As with most films, you will need to emphasize the point that only green plants, not animals, have the ability to manufacture food.

New words and words for discussion:

photosynthesis
stomates
starch
Chlorophyll
sugar
oxygen

Suggested questions for discussion:

1) What type, or group, of plants produce most of the food within the oceans?

2) How deep does sunlight penetrate the ocean surface?

3) Where does the energy stored in food come from?

4) What material is made by green leaves when exposed to sunlight?

5) Why was starch found only in green leaves?

6) What does a green plant need to make food?

7) Which is made first, sugar or starch?

8) Where does the oxygen go that is produced?

9) Can green plants grow without sunlight?

10) Where does the carbon dioxide used by the plants come from?

11) Where does most of the food production occur, in the ocean or on land?

12) Why were the leaves placed in hot water?

13) What affect did the alcohol have on the leaves?

14) When iodine turns material dark, what does this indicate is present?

LEARNING ABOUT LEAVES

16 min. - color - EBE Corp.

This film shows several experiments related to food production within the leaves. Some of these experiments could be performed in the classroom. The film does a fairly good job of explaining the materials needed for food manufacturing and how these materials are used by the plants.

You will need to emphasize that only green plants are capable of capturing the sun's energy and making food. If you repeat the experiment using alcohol, do not get alcohol near an open flame.

New words and words for discussion:

chlorophyll
time lapse photography
starch
food
leaf scars
energy

Suggested questions for discussion:

1) In what part of the plant is sugar formed?

2) What materials are used by plants in making food?

3) Why do they take the chlorophyll out before testing for starch?

4) Finding starch in a leaf proves what?

5) Why do plants that live more than one year store food in their roots?

6) Why is food stored in seeds?

7) Do all plants make food?

8) Does the shape of a leaf affect its ability to make food?

9) Will plants grow in the dark?

10) Can all colors of light be used by plants to make food? How could this be tested?

11) Could animal life exist without green plants?

12) What should we do with leaves when they fall from trees?

Suggested follow-up activities:

1) Make a classroom leaf collection. Caution the students about collecting too many leaves from one tree!

2) Compare several leaves from one tree. Are they all the same shape and size?

3) Use iodine to test various foods for starch.

4) List some plant roots we eat.

5) Grow one plant in the light while a like plant is grown in the dark.

6) Collect some twigs and view them for leaf scars.

PLANTS MAKE FOOD

11 min. - color - Churchill

Uses animation in portions of the film to help illustrate how plants make food. Very basic, but well explained for an introduction. You will need to emphasize only green plants are capable of producing food and that all animals depend on the green plants for food. Contains some experiments that can be performed in the classroom.

New words and words for discussion:

Carbon dioxide
chlorophyll
minerals
root hairs
starch
weeds

Suggested questions for discussion:

1) How do minerals get into the plants?

2) What function do the root hairs perform?

3) What function does the stem perform for a plant?

4) Do all leaves have the same vein patterns?

5) In what form is food stored by plants?

6) Are weeds important food producers?

7) Diagram a plant and label what each part does in the production of food.

8) Can leaves make food at night?

9) What are some of the consumers shown in the film?

ENERGY FROM THE SUN

11 min. - Black and White (older film) - EBE Corp.

A good film showing how everything depends on the sun for energy. Delves into the different ways energy is captured and used on the earth; green plants, water cycle, winds, coal and oil. It gives a quick review of the food production within a green plant, but is no substitute for the other films dealing with photosynthesis. This film will be very useful for those teachers wishing to expand on the concept of energy and its uses. The teacher will need to give simple definitions of such words as chemical energy, molecules, and radiant energy. Do not have the students look at the sun even with dark glass as suggested in the film. When the film discusses thermo-nuclear reactions, just explain that it is a reaction that releases a lot of energy mostly in the form of heat and light.

Suggested questions for discussion:

1) What would the earth look like without the sun?

2) What do we get from the heat and light sent out by the sun?

3) Is the sun burning itself up?

4) What happens when water molecules are heated?

5) Does it take energy to evaporate water?

6) Does falling water contain energy?

7) What is the only way food can be manufactured?

8) What is the source of all energy on the earth?

9) How is coal formed?

10) What patterns would you expect to find in coal?

11) Do plants decay when they form coal?

12) How is oil formed?

13) What would be true about the decomposing process if coal and oil are formed? Was the material completely decomposed?

14) Can man create energy?

15) List some ways energy is stored on the earth.

16) Does the fuel used by the family car depend on the sun?

Additional Activity:

Find material telling about new ways man is using the sun's energy. For example - to distill water.

FOOD GETTING AMONG ANIMALS

13 Min. - Color - **Moody**

"Food Getting Among Animals" illustrates five different predator-prey relationships. It does an excellent job of illustrating how the organisms are adapted to locate and capture their food. It also briefly explains how some of the animals are adapted for protection and locomotion within their environment. You may wish to view this film, discuss some of the questions, direct attention toward certain portions, and view it a second time. The information about the rattlesnake will need considerable explanation if students are to understand it.

New words and words for discussion:

predator
prey
protective coloration
prehensive
refraction
infra-red rays

Suggested questions for discussion:

1) What is the predator and the prey in each of the illustrated relationships?

2) Who benefits and who loses as a result of each relationship?

3) What special adaptations does the anteater possess to aid his food gathering?

4) What organ does the rattlesnake use to locate food?

5) Does the barnacle chase its food?

6) How long is the chameleon's tongue compared to its body length?

7) What is unusual about the chameleon's eyes, feet and skin?

8) How are these unusual structures helpful to the chameleon?

9) Would you expect to find an anteater in a grassland?

10) Do you think rattlesnakes will eat dead animals?

THE WOOD DUCK'S WORLD

30 Min. - Color - Ducks Unlimited

The struggle for survival during a year in the life of a wood duck family is illustrated. A realistic presentation illustrating everything from competition for nesting sites, to death of the weak, and on to predation. Emphasis is placed on the fact that more young are produced than will survive and how a balanced environment is maintained without man's influence.

New words and words for discussion:

Carnivores
Scavengers
Balanced Environment
Competition
Predator
Prey
Population
Adaptation

Suggested questions for discussion:

1) If all the young produced by animals lived, what effect would it have on the balance of nature?

2) Why do you think the male is often more colorful than the female among wildlife?

3) Why are most young of wildlife hatched in the spring?

4) Where is the only place wood ducks will nest?

5) What are some competitors for the duck's nest sites?

6) What happens to each of the ducklings?

7) What do the ducklings eat?

8) What do the adult ducks eat?

9) What predator-prey relationships are illustrated?

10) Is man a predator?

11) What adaptation helped the hawk capture the duck?

12) Should man kill the predators to protect the ducks?

13) Diagram a food chain illustrated in the film.

NATURE'S HALF ACRE

30 min. - color - Disney

Excellent color photography of natural situation. Most of the film is showing spring and summer conditions. Emphasis is placed on various predator-prey relationships that could be found in most "natural" areas. The concept "some must die so that others may live," is well illustrated. The film does a good job of illustrating the variety of life that can exist in a small area. Some bird sounds are recorded on the sound track. A quick view of the plant and animal changes through the seasons is given.

Suggested questions for discussion:

1) List some predator-prey relationships that were illustrated.
2) Diagram some food chains and food webs that were illustrated.
3) What example of a parasite-host relationship was illustrated?
4) What were some examples of competition between organisms?
5) Describe some structural adaptations that helped predators capture their prey.
6) Can a plant be a predator?
7) Why do some species produce a large number of offspring?
8) What type of materials do birds use for nest building?
9) In what season are most new offspring hatched or born?
10) What are some examples of how plants and animals were affected by changing seasons?
11) What are some patterns that exist within nature?
12) What would be the result if all offspring lived to adulthood?

LIFE STORY OF THE GRASSHOPPER

11 Min. - Color - EBE Corp.

The grasshopper life cycle and its role within food chains are illustrated. Good for showing interaction between organisms.

Suggested questions for discussion:

1) Where can grasshoppers be found?

2) Does the grasshopper compete with man for a food supply?

3) What are the major body parts of the insects?

4) How many eyes does a grasshopper have?

5) How many legs does a grasshopper have?

6) Does a grasshopper go away or toward light and sound?

7) For what does the grasshopper use its tympanum?

8) Would a grasshopper drown if its head was under water?

9) Describe some of the grasshopper's adaptations that help it survive.

10) Diagram a food web as illustrated in the film.

11) What are some animals that prey on the grasshopper?

12) Why does nature have the grasshopper lay so many eggs?

13) Where do grasshoppers lay their eggs?

14) How many years do grasshoppers live?

15) Why do grasshoppers molt?

16) Do the young appear the same as adults?

17) Is the use of chemicals the best way to control the grasshopper population?

18) What are some problems resulting from the use of chemicals?

19) If all grasshoppers were destroyed what animals would be affected?

Additional Activity:

Do some research to find out if grasshopper populations have ever been an important problem for man.

LIFE IN A POND

11 Min. - Color - Coronet

Easy to understand. Shows the organisms and their interaction within a typical pond. Illustrates the life cycles of some insects associated with the pond. Good example of the food chains within the pond. Would help student understanding on the field trip. Could be followed by student reports about several of the organisms illustrated.

Suggested questions for discussion:

1) What is a pond?

2) What type of life is most common in a pond?

3) Could animals live in a pond without plants?

4) What are some ways to study the life in a pond?

5) Why are the microscopic plants and animals important?

6) Diagram some food chains that are found in a pond.

7) What special adaptation does the dragonfly nymph have for capturing food?

8) Is the dragonfly nymph a predator?

9) Name some animals you would expect to find in a pond.

10) Is it bad that one animal eats another?

11) Does man fit into any food chains involving the pond?

12) How does man's actions affect the life in a pond?

POND ANIMALS

11 Min. - Color - Coronet

A good film to show before the field trip as it shows methods for studying the organisms found in the water samples they will collect. In addition to the microscopic life of a pond, the film also views some of the larger organisms. Students may wish to do further study about some of the organisms illustrated. Several micro-organisms' names are given, but this does not create much of a problem.

Suggested questions for discussion:

1) What do you think lives in a pond? (Use before showing the film)

2) Why are some of the larger pond animals hard to see?

3) Describe the areas within a pond where most of the animals live. Why are they in these locations?

4) Diagram some food chains that can be found in a pond.

5) What are some examples of predator - prey relationships?

6) Can microscopic organisms contain chlorophyll?

7) If microscopic organisms contain chlorophyll are they plants or animals?

8) Why do you want to keep carnivorous animals in a separate jar from other animals?

9) Describe some of the food gathering structures of pond animals.

SECRETS OF THE ANTS AND INSECT WORLD

13 Min. - Color - Disney

A very interesting film to view. It illustrates the variety of roles within an ant colony and the interactions of ants with other organisms.

Suggested questions for discussion:

1) Does each ant perform all duties within an ant colony?

2) How do the honey ants store their honey?

3) Why are ants called subterranean organisms?

4) Describe some of the various roles the individual ants perform.

5) Diagram some food chains of which ants are a part.

6) What are some examples of predators that use ants for prey?

7) What are some examples of prey for ants?

8) How many legs does an ant have?

9) What structure is most important to the ant for use in self-defense?

10) What do the black ants want from the red ants when they attack?

11) Why did the honey ants gather portions of green leaves?

12) Describe the life cycle of an ant.

13) How many different kinds of ants are there?

14) Are ants beneficial to man? How?

SURVIVAL OF THE KIT FOX

15 Min. - Color - Journal

This film shows the struggle the kit fox goes through in order to survive, with emphasis on its obtaining food. The film brings out how man unknowingly destroys the balance of nature and, as a result, is destroying the food source of the kit fox. The film will need careful discussion to bring out many of its worthwhile points. Good for showing the interaction between animals.

Suggested questions for discussion:

1) Why do people change the land where they live?

2) What animals are prey for the kit fox?

3) When are kit foxes born?

4) How does the kit fox help man?

5) Diagram some food chains in which the kit fox is a part?

6) What do the field mice eat?

7) What adaptation helps the kit fox obtain food?

8) How do animals adapt to survive the winter?

9) How does the kit fox store food?

10) Why were the kit foxes scratching themselves?

11) What are some of the natural enemies of the kit fox?

12) What is the greatest enemy of the kit fox?

13) How can man's use of insecticides harm the kit fox?

14) What additional problems will man have if all kit foxes disappear?

15) What are two other names given to the kit fox?

WORLD IN A MARSH

30 min. - color - McGraw-Hill

This film is very colorful, and generally easy to follow. Teacher guidance will be needed to review the large number of concepts illustrated. Most of the natural relationships, except decomposers, that would be found in any habitat, are included in this illustration of marsh life.

Suggested questions for class discussion:

1) Is the dragonfly a predator?

2) Can the dragonfly be prey? For what kind of animal?

3) What are some examples of competition? (for mates, for food, for space)

4) Where is the bullfrog's ear?

5) Why does the big sack form below the jaw of a frog when it croaks?

6) If there are 200 frogs in the pond one year, how many do you expect the next year?

7) Where does the dragonfly lay its eggs?

8) Why do people destroy areas like the marsh?

9) How does a marsh help the area surrounding it?

10) Do all frogs make the same type of sound?

11) What animal eats dragonfly eggs?

12) In what part of the country was this film photographed?

13) What type of plants are most common in a marsh?

14) What are some predator-prey relationships illustrated in the film?

15) Are any decomposers illustrated in the film?

16) Name some producers found in a marsh.

17) How is a frog and duck similar?

18) How does a baby duck and baby blackbird differ?

19) What eats frogs?

20) Describe the life cycle of a dragonfly.

21) Name some special adaptations of animals that live in a marsh.

22) What kind of food does a duck find in a marsh?

23) What kind of life can be found on the bottom of a marsh?

24) What is larva?

25) Why do male bullfrogs fight with each other?

26) What type of nest does the grebe build?

27) Do all eggs hatch and survive?

28) What is necessary in order to have a marsh?

29) Why do the birds chirp at night?

30) Describe four food chains illustrated in the film.

31) Diagram a food web for a marsh similar to the one illustrated.

SUCCESSION FROM SAND DUNES TO FOREST

16 Min. - color - EBE Corp.

This film was produced on the south side of Lake Michigan where various stages in the change from sandy beaches to forest areas can be viewed. Factors bringing about changes from one stage to the next, and the life associated with each stage or type of habitat is illustrated.

New words and words for discussion:

ecological succession
climax forest
humus
blowouts
pioneer community
drift

Suggested questions for discussion:

1) Why are more complex food webs associated with a climax community than with a pioneer community?

2) Does succession ever stop?

3) What is an example of an early pioneer plant?

4) Does the animal life in the area remain the same when the plant life changes?

5) Are decomposers important in determining the rate of change from one stage to the next?

6) Would you expect the same pattern of succession for all parts of the world?

7) What is needed to change from a pioneer to climax community?

8) What were the steps in changing from sand to forest?

9) What is drift?

10) What were some food chains associated with each stage?

11) What can destroy a climax community?

12) From the film, can you give examples of: predators, prey, producers, decomposers, competition, and parasites?

PLANT AND ANIMAL COMMUNITIES: ECOLOGICAL SUCCESSION

13 1/2 min. - color - Coronet

A good film for illustrating the natural processes involved in the changing of a barren area into a complex community of plants and animals. Most of the emphasis is on land communities, but a brief discussion of water succession is included. This film could be used in preparing for the field trip. Some discussion of a food web could also be developed following the viewing.

New words and words for discussion:

biome
succession
balanced community
dis-climax
climax community
organic matter
humus

Suggested questions for discussion:

1) What determines the types of plants that will live in an area?

2) Which develops first in a new area - plants or animals?

3) What type of plant moves into a barren area first?

4) In what way does the burrowing animals help develop an area?

5) What happens to the bodies of the first plants and animals that live in an area?

6) What must there be a lot of before a complex community can develop?

7) Arrange the following in the normal sequence they would follow if no disturbance occurred: mosses, weeds, conifers, lichens, fast growing trees, deciduous trees.

8) What type of things alters the natural changes occurring in a community?

9) Does man's actions ever conflict with nature's processes? Give some examples.

10) What kind of life first appears in a new body of water?

11) What type of community was Kansas before it was settled by pioneers?

12) How much rainfall is needed per year in order for plants larger than grass to grow?

13) What determines the type of climax community for any area?

LAKES: AGING AND POLLUTION

15 min. - color - Centron

A good film for dealing with the structure of a lake, the organisms within a lake, the interactions between organisms, and how man is changing the rate of aging of lakes. A very interesting film that keeps the vocabulary level simple. There is a diagram on pond succession (Appendix B) and an article on Aging of Lakes (Appendix D) that go very well with this film.

New words and words for discussion:

minerals habitats communities organisms algae

Suggested questions for discussion:

1) What is a lake and how are they formed?

2) Does the life in different lakes differ?

3) How large are most of the organisms that are found in water?

4) What part of a lake contains plants with roots?

5) What plant provides most of the food for lake animals?

6) Why do some kinds of animals live only in certain parts of a lake?

7) Name two basic needs of the animals living in a lake.

8) Describe some adaptations that allow animals and plants to live in a certain depth or habitat.

9) Diagram some food chains that are illustrated in the film.

10) How does an old lake differ from a young lake?

11) Where do the minerals come from that are found in an old lake?

12) What happens to lake plants and animals when they die?

13) What causes some water to appear green?

14) What uses the oxygen in an old lake?

15) What is formed when a lake dies?

16) How has man influenced the rate of aging?

17) How does man use water?

18) Why is our need for water increasing?

19) Why is the water from a young lake better for man's uses?

20) Sketch the stages a lake goes through during its life cycle.

21) Listen to the fishing reports for the Kansas lakes and see if the same kinds of fish are being caught in all the lakes? Which are old lakes and which are new lakes?

FUNGI

15 min. - color - EBE Corp.

A good film to illustrate the variety of plants that are included in the fungi group. The film uses several specific plant names and is somewhat technical in places, but this does not interfere with the students gaining a good general understanding of the fungi group. Well worth viewing either before or following the field trip. Some experiments are included that could be performed in the classroom. You will need to emphasize the decomposing role of the fungi.

New words and words for discussion:

spores
enzymes
parasites
antibiotics
saprophytes
penicillin
organic
hyphae

Suggested questions for discussion:

1) What are some ways fungi differs from green plants?

2) Why is the fungi group called simple plants?

3) What are some examples of fungi plants?

4) How are fungi plants helpful to man?

5) Why are fungi called dependent plants?

6) What are some problems fungi causes man?

7) Does fungi need sunlight in order to live?

8) What kind of conditions do spores need before they will grow?

9) What do bakers put in bread to stop mold from growing?

10) Is the decay caused by fungi always bad?

11) Give some examples of how fungi interact with other organisms.

12) Give some examples of how fungi are adapted to protect themselves.

13) Do all fungi have a definite pattern and shape?

14) Can the fungi group be called decomposers? Why?

LIFE IN THE OCEAN

17 min. - color is red tone - Film Assoc.

The film surveys some types of ocean plants and several types of ocean animals illustrating how they are adapted to survive in that portion of the ocean they are found. Emphasis is placed on mobility, protection, and food gathering structure. Fairly good for showing the variety of animals that exist in the ocean.

Suggested questions for discussion:

1) What are diatoms? This would be a good topic for some research.

2) Where will plants needing sunlight be found within the ocean?

3) What is an oceanarium?

4) Do all animals move or are some attached to rocks and other things?

5) How do some ocean animals protect themselves?

6) What special protection does the crab have?

7) Do all fish have a backbone?

8) What is different about the way a fish and a turtle get air?

9) Can animals with lungs stay under water as long as those with gills?

10) Are all ocean animals fish?

11) Describe some ways ocean animals vary.

12) How is a sea horse and monkey alike?

ANIMAL TRACKS AND SIGNS

11 min. - color - EBE Corp.

The story is portrayed by two elementary age children. Good for showing how by careful observing of animals signs, one can determine which animals have been in an area without ever seeing them. Illustrates the the use of mud for duplicating animal tracks.

New words and words for discussion:

nocturnal prey predator

Suggested questions for discussion:

1) Why are some animals called nocturnal naimals?

2) Name several signs that can be used to tell animals have been in an area.

3) Diagram the food chains that are illustrated in the film.

4) What are some examples of animals depending on plants?

5) Where can animal signs and tracks be found?

6) Are there any animals with special adaptations shown?

Follow-up activities:

Have some students collect some mud tracks. Cast plaster of Paris tracks from the mud tracks. Write stories based on the tracks they find.

WHY PLANTS GROW WHERE THEY DO

11 min. - color - Coronet

A very good film dealing with plants that have adapted to live in a wooded area, a grassland area, a desert area, and water. A good discussion of how plants have adjusted to the climatic conditions in each habitat. Gives illustrations on establishing a terrarium for each area. This would be a good film to show before or just after the field trip.

Suggested questions for discussion:

1) Name some of the things plants need in order to live.

2) What adaptation do grassland plants have that help them withstand wind?

3) Do plants affect the climate where they are growing? If so, how?

4) How do grassland plants differ from woodland plants?

5) Do all plants grow in the soil?

6) Do all plants need sunlight?

7) Describe two adaptations of desert plants that help them conserve water.

8) Why do desert plants not grow close together?

9) Where do water plants obtain air?

10) Briefly describe the conditions (climate and plants) for each of the following: woodland, grassland, pond, and desert.

11) Do all plants need the same amount of each of the basic materials (carbon dioxide, sunlight, and water)?

12) Do individual plants adapt in order to live in an area or do they live in the area because through many thousands of years their species has developed the needed traits to survive in that type of environment.

HOW NATURE PROTECTS ANIMALS

11 min. - color - EBE Corp.

Shows ways animals are adapted to survive in their habitat. Gives some good illustrations of protection through hiding, fleeing, and discouraging attacks. A few words are used that will need teacher explanation.

Suggested questions for discussion:

1) What adaptations do those species like sowbugs have that allow them to survive the longest?
2) Describe some adaptations that help other animals survive.
3) What are the three major ways animals have to escape their enemies?
4) What are some examples of camouflage?
5) How do most larger grassland animals escape?
6) What are some examples of how insects escape their enemies?
7) What would be the effect if all animals lived a complete life?
8) If there were no predators, could there be any animals other than herbivores?
9) Is it the weaker or stronger animals that tend to be captured?
10) What are some of the oldest living species?
11) How does man protect himself?

WHAT ECOLOGISTS DO

15 min. - color - Centron Ed. Films

Illustrates methods used by ecologists in studying wildlife populations and the type of information they collect. Very simply explained and well illustrated.

Suggested questions for discussion:

1) Why are there very few bald eagles present today?

2) What organisms are involved in the bald eagle chain?

3) Why is the poison stronger in the bald eagle than in the fish?

4) What is ecology all about?

5) What is an ecologist?

6) What type of information do ecologists need to know?

7) Why is it that ecologists cannot collect all the organisms in a given area for studying?

8) How do ecologists determine the number of organisms in an area?

9) Describe some of the ways used to sample populations.

10) How can one determine how old a tree is?

11) Do ecologists kill all the animals they study?

12) Why do ecologists raise animals and plants in laboratories?

13) What type of information do ecologists gain by reading books?

14) Are the ecologists concerned with the non-living things in the environment? Why?

15) What organism has the greatest influence on the environment?

16) What is pollution?

17) Do the same organisms live in polluted water as live in non-polluted water?

APPENDIX B

Diagrams

(Student Materials)

The following diagrams can be used for making transparencies for student handouts or as part of bulletin board displays.

For Use With The Basic Needs Of Life

Sunlight and Green Plant Interaction. .B- 2

Food-Oxygen Interaction Within Animals. . . . . .B- 3

Plant and Animal Relationships. . . . . .B- 4

For Use With Food Web

Food Chain in Water . . . . .B- 5

Food Chain on Land. . . . . .B- 6

Matter Cycle Illustrations. . . . . .B- 7

Water Cycle . . . . .B- 8

An Energy Chain . . . . .B- 9

Pyramid of Matter and Numbers B-10

Adaptation Diagrams B-11

Parasite Life Cycles. B-15

For Use When Studying Change and Populations

Population Cycle. B-18

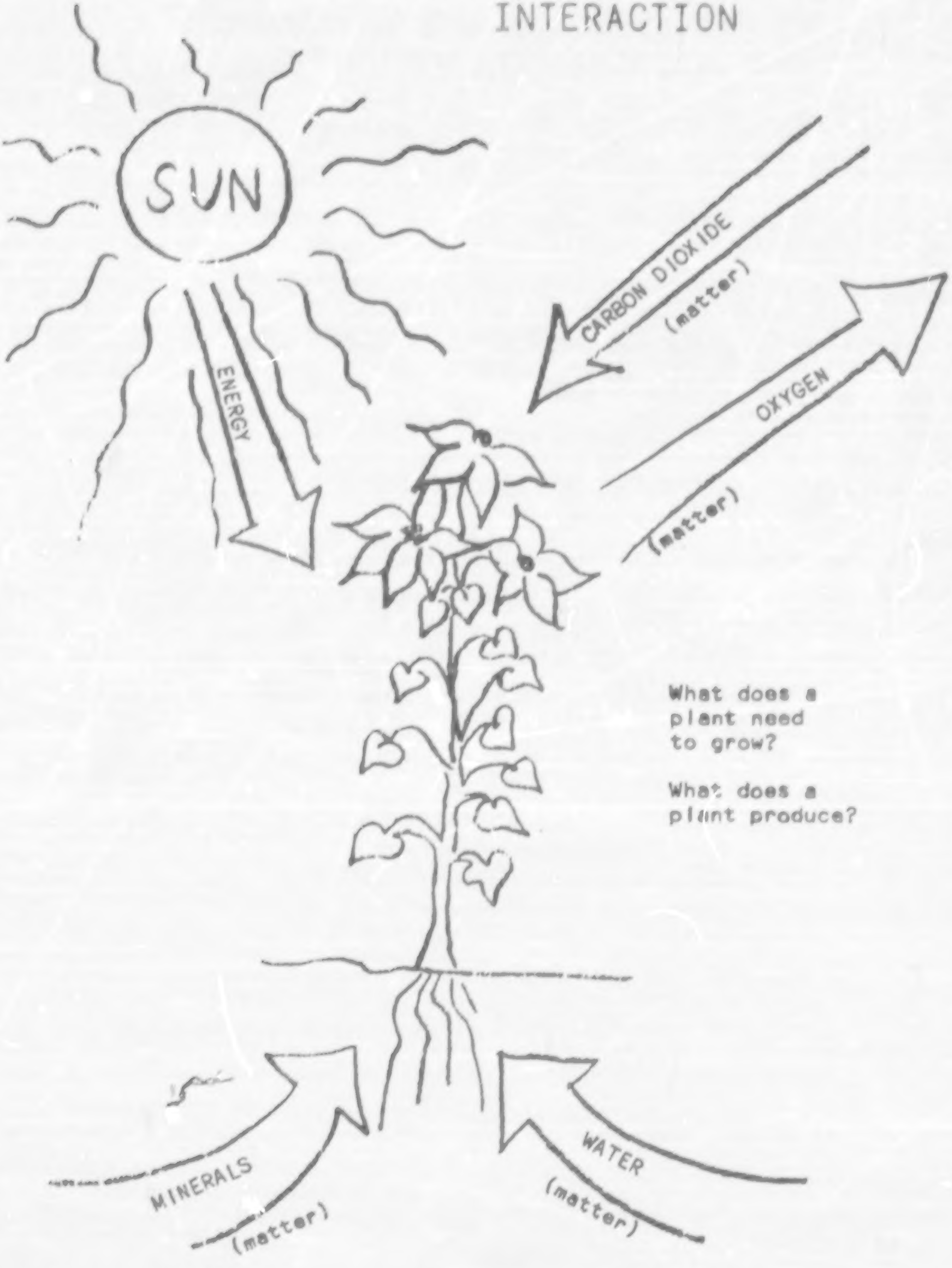
Factors Controlling a Population. B-19

Carrying Capacity of Habitats B-20

Pond Succession B-21

U. S. Virgin Forest Change Over 100 Years B-22

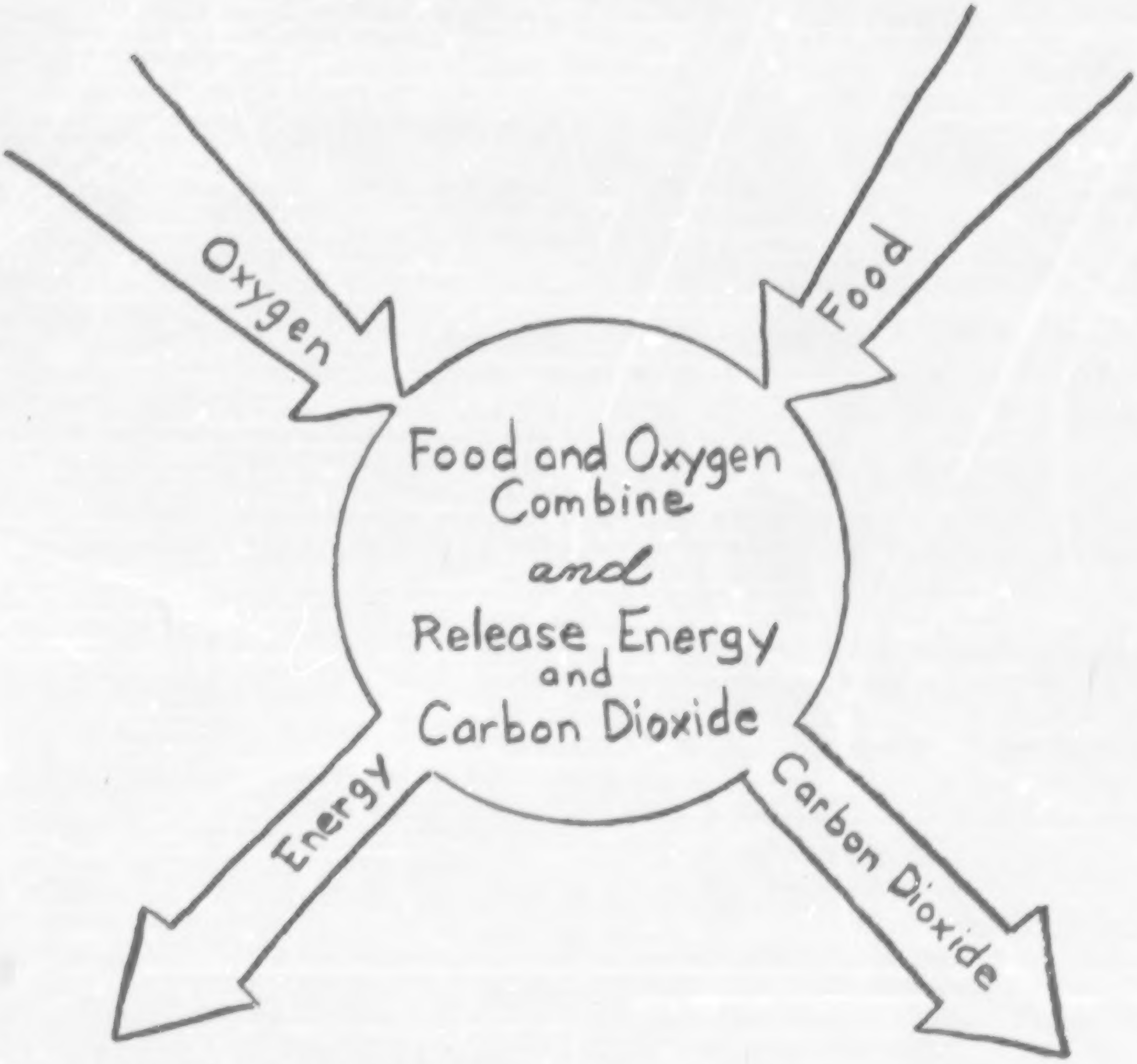
SUNLIGHT and GREEN PLANT INTERACTION


SUN
ENERGY
CARBON DIOXIDE
(matter)
OXYGEN
(matter)
MINERALS
(matter)
WATER
(matter)

What does a
plant need
to grow?

What does a
plant produce?

FOOD-OXYGEN INTERACTION WITHIN ANIMALS


Oxygen
Food
Food and Oxygen Combine
and
Release Energy and Carbon Dioxide
Energy
Carbon Dioxide

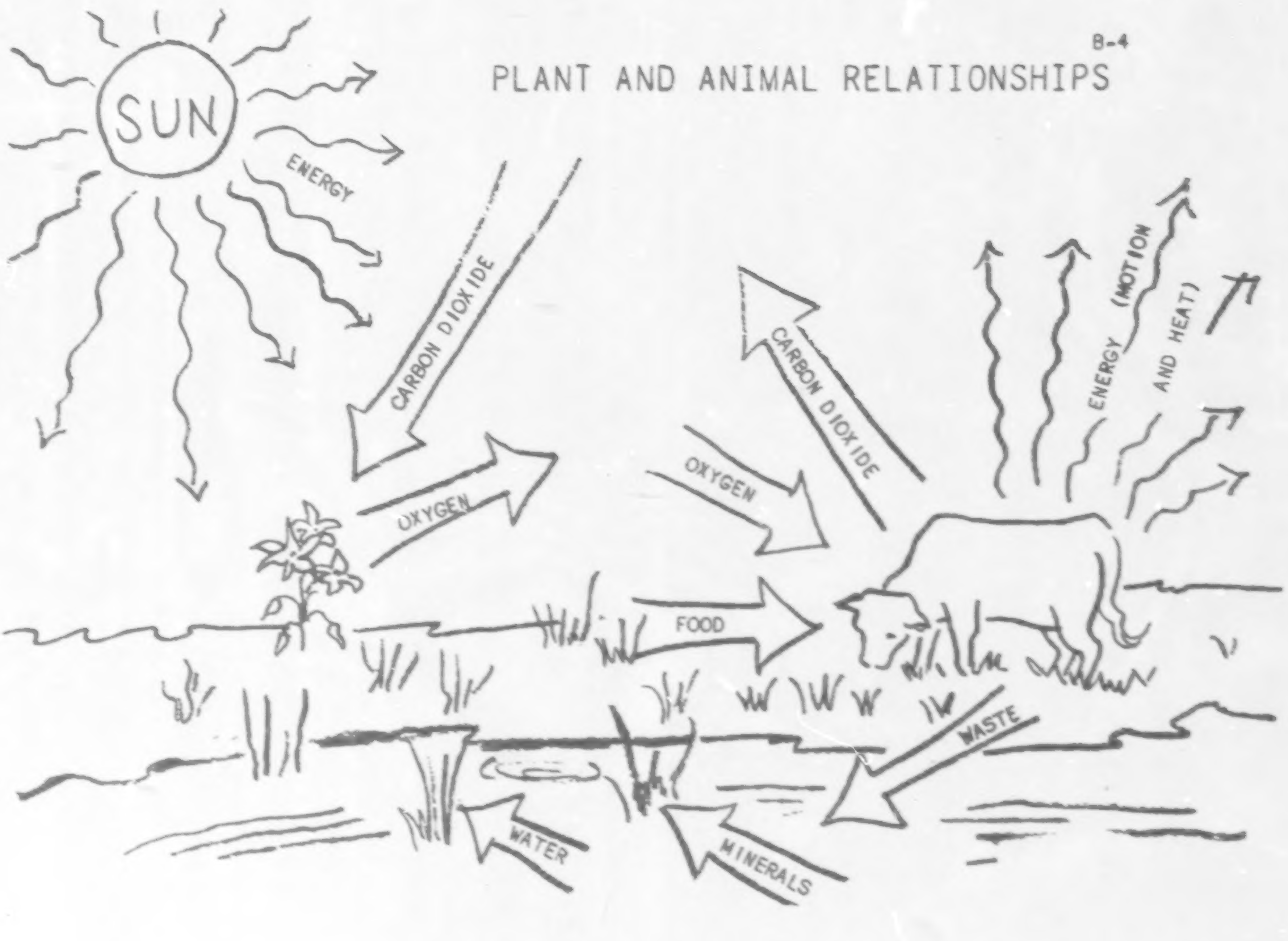
Where does the animal get the oxygen?

What makes the animal's food?

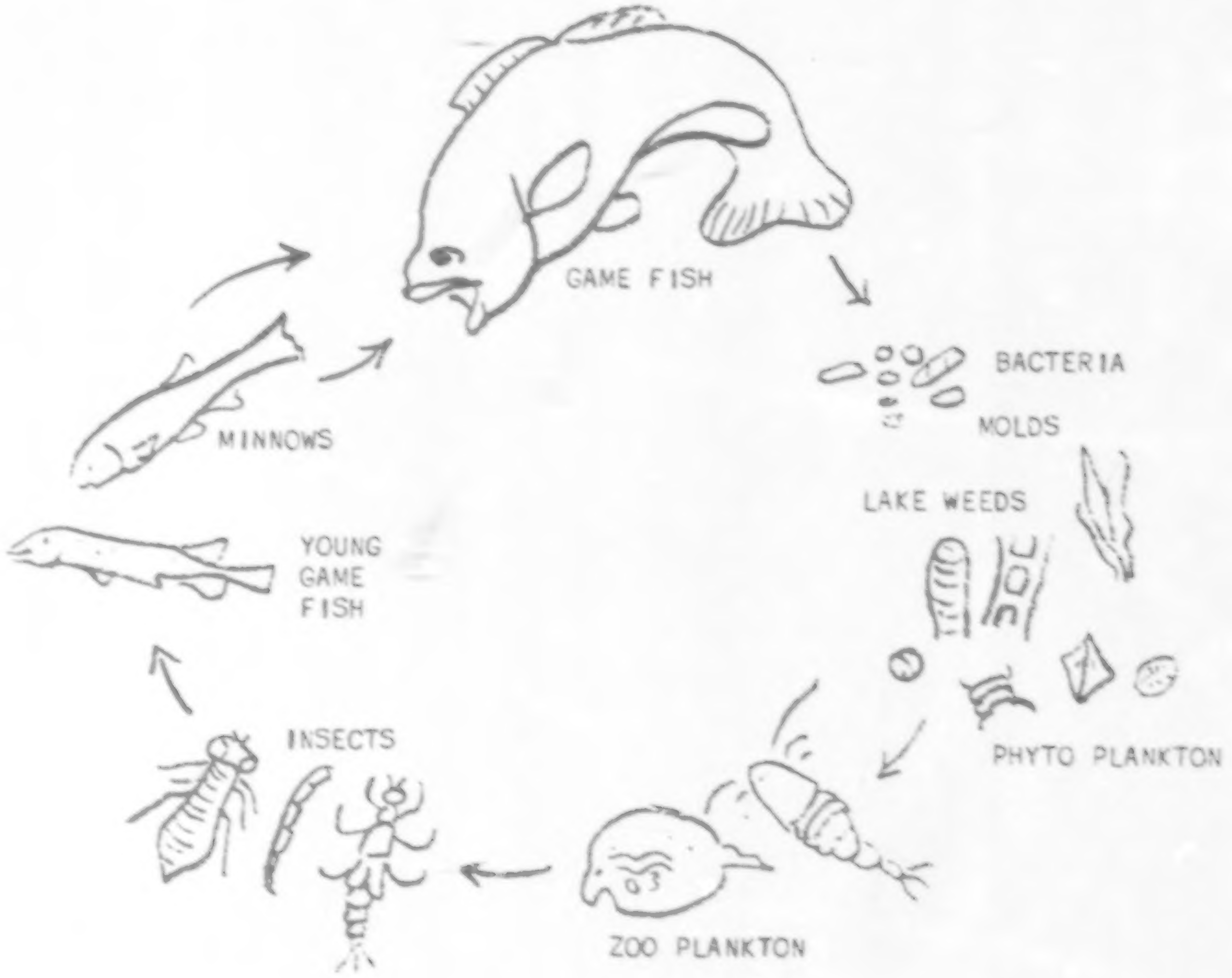
How do animals use energy?

Note: This occurs within the animal's cells.

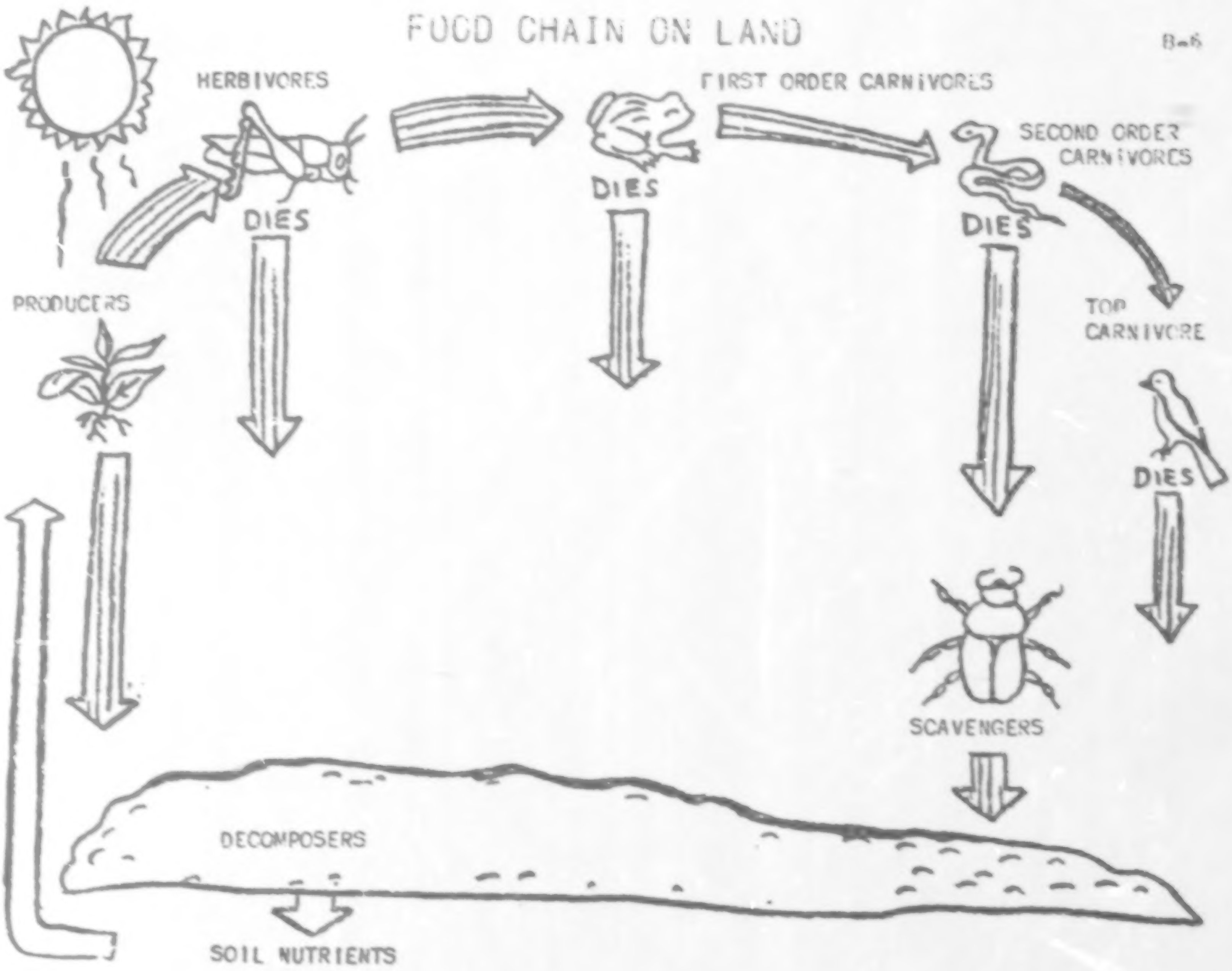
PLANT AND ANIMAL RELATIONSHIPS


SUN
ENERGY
CARBON DIOXIDE
OXYGEN
OXYGEN
CARBON DIOXIDE
ENERGY (MOTION AND HEAT)
FOOD
WASTE
WATER
MINERALS

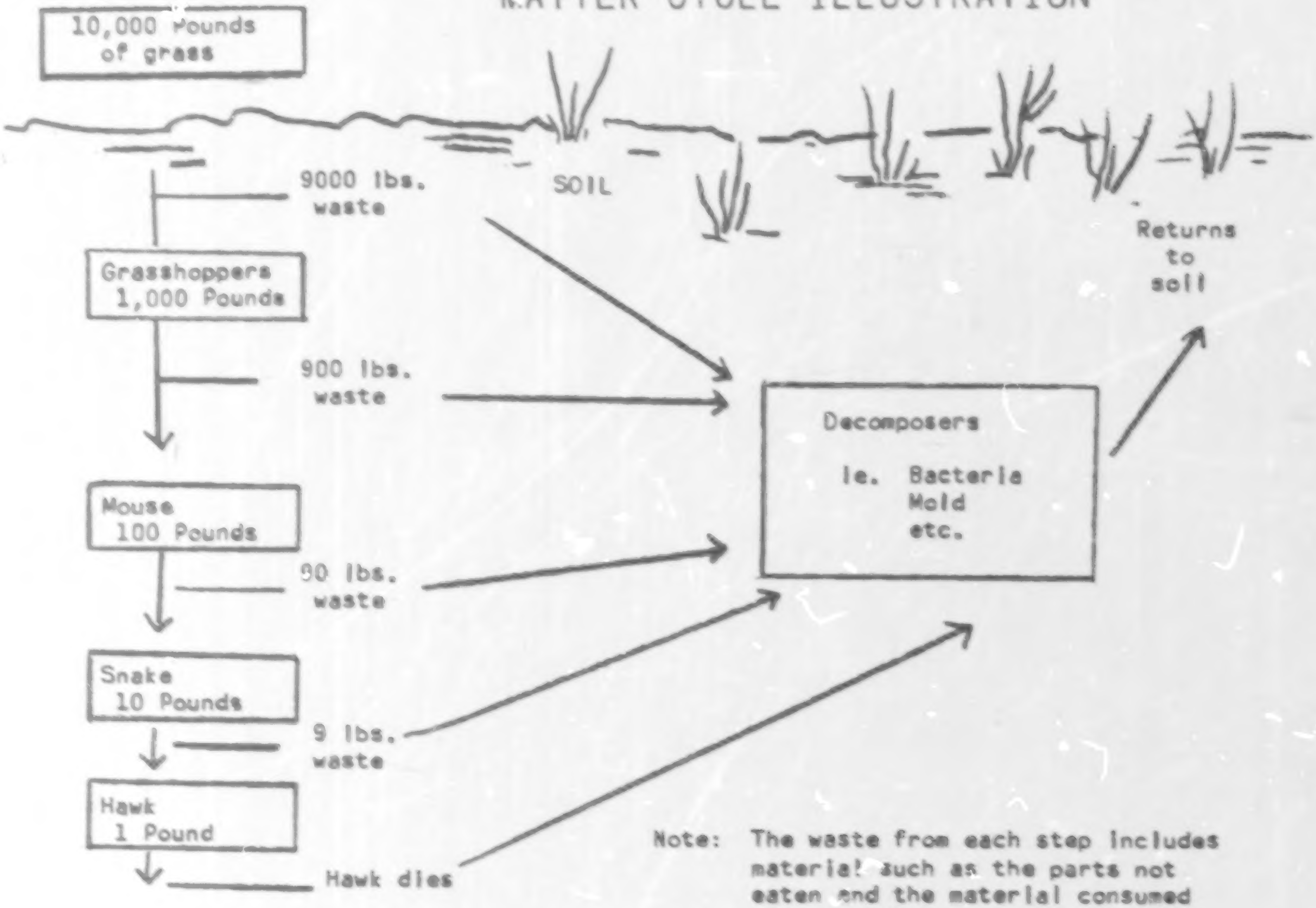
FOOD CHAIN IN WATER


GAME FISH
BACTERIA
MOLDS
LAKE WEEDS
PHYTO PLANKTON
ZOO PLANKTON
INSECTS
YOUNG GAME FISH
MINNOWS

FOOD CHAIN ON LAND


HERBIVORES
FIRST ORDER CARNIVORES
SECOND ORDER CARNIVORES
PRODUCERS
DIES
DIES
DIES
TOP CARNIVORE
DIES
SCAVENGERS
DECOMPOSERS
SOIL NUTRIENTS

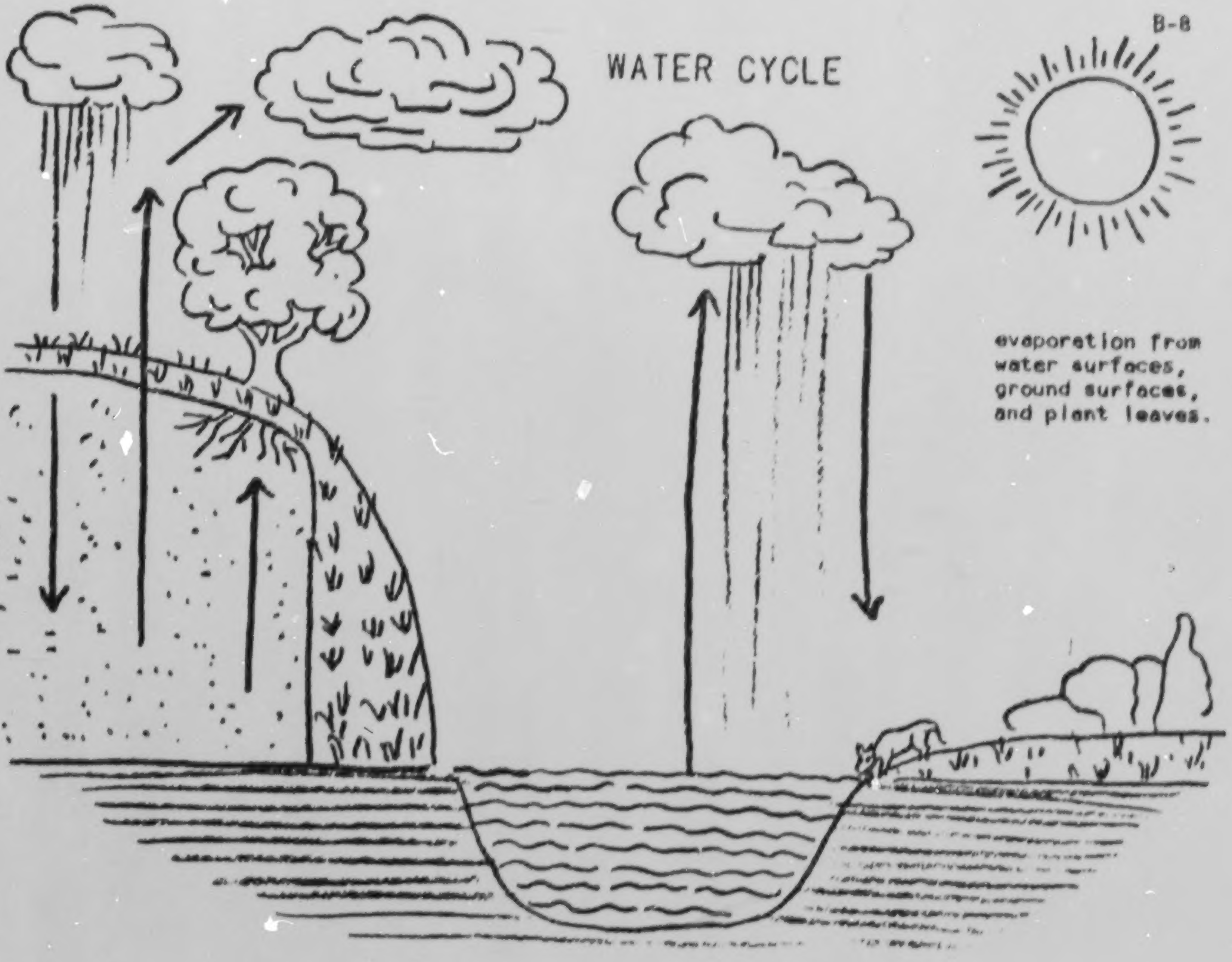
MATTER CYCLE ILLUSTRATION


10,000 Pounds of grass
SOIL
9000 lbs. waste
Grasshoppers 1,000 Pounds
900 lbs. waste
Mouse 100 Pounds
90 lbs. waste
Snake 10 Pounds
9 lbs. waste
Hawk 1 Pound
Hawk dies
Decomposers
ie. Bacteria
Mold
etc.
Returns to soil

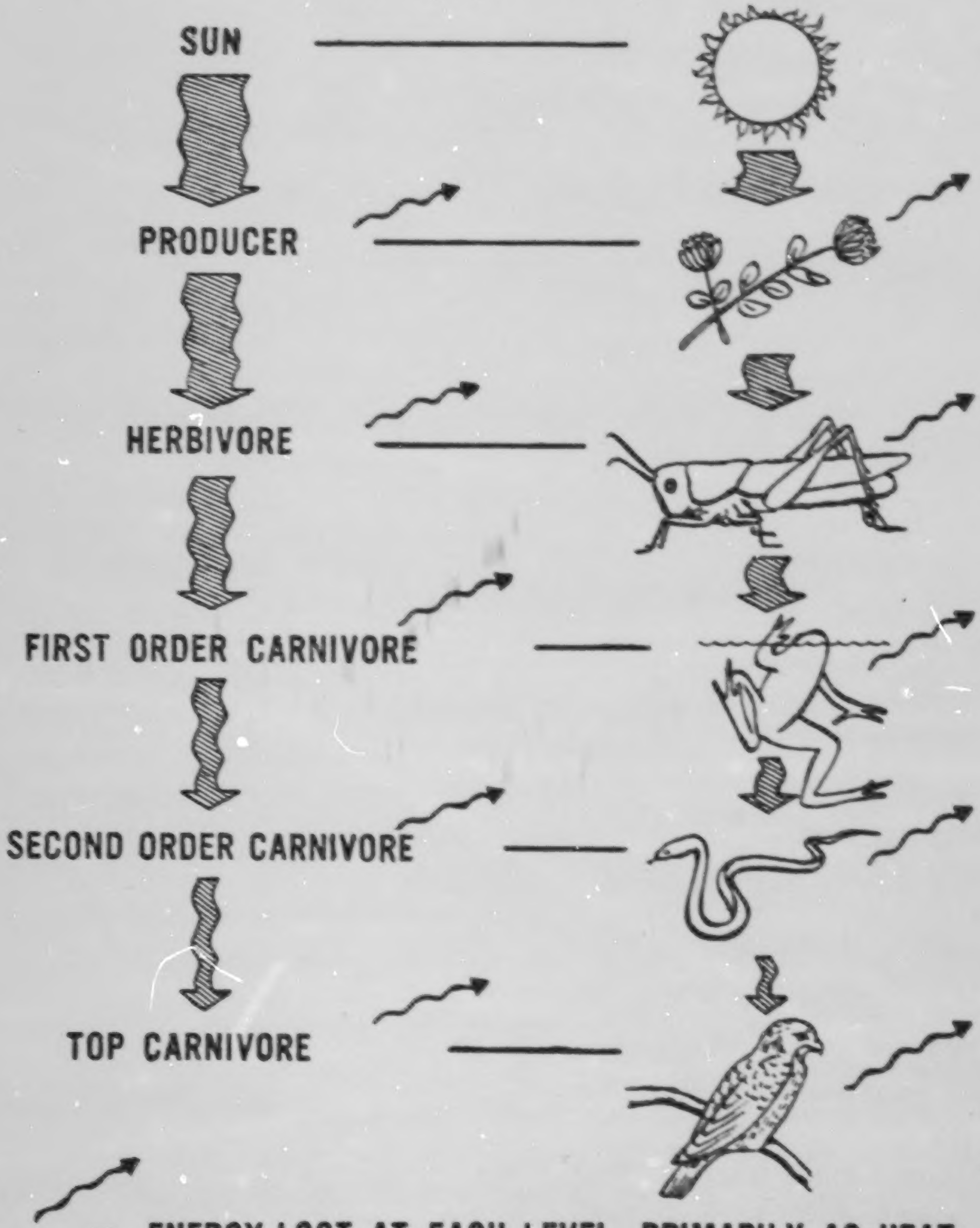
Note: The waste from each step includes material such as the parts not eaten and the material consumed but passed through the consumer.

B-8

WATER CYCLE


evaporation from
water surfaces,
ground surfaces,
and plant leaves.

AN ENERGY CHAIN



SUN

PRODUCER

HERBIVORE

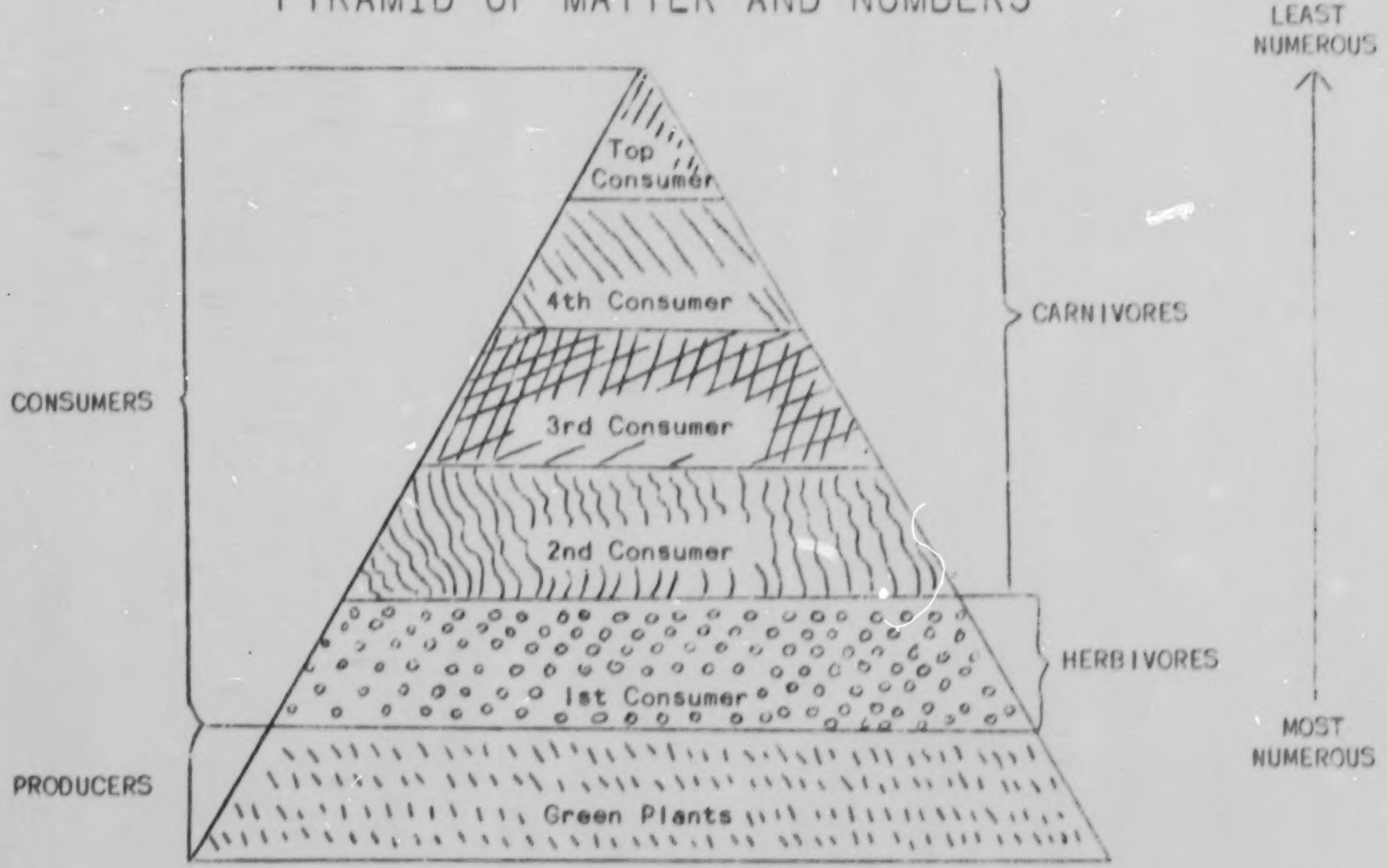
FIRST ORDER CARNIVORE

SECOND ORDER CARNIVORE

TOP CARNIVORE

= ENERGY LOST AT EACH LEVEL, PRIMARILY AS HEAT

PYRAMID OF MATTER AND NUMBERS


LEAST NUMEROUS
Top Consumer
4th Consumer
CARNIVORES
CONSUMERS
3rd Consumer
2nd Consumer
1st Consumer
HERBIVORES
PRODUCERS
Green Plants
MOST NUMEROUS

Note: 1) In any food chain there are fewer top level consumers than producers.
2) The matter removed from the food chain is returned to soil by decomposers.
3) This illustration is not proportional as each level should be about one-tenth the size of the one below it.

ADAPTATION

For teacher reference when using the bird feet diagram.

1. Leg and foot of a water bird that feeds by wading in shallow water and shoreline areas. Foot not adapted for swimming.

2. Leg and foot of grassland bird. Many forest birds have similar feet. Toe nails tend to be developed for digging among ground litter. Some of the perching birds have two toes forward and two backward for grasping tree limbs or bark--the woodpecker for example.

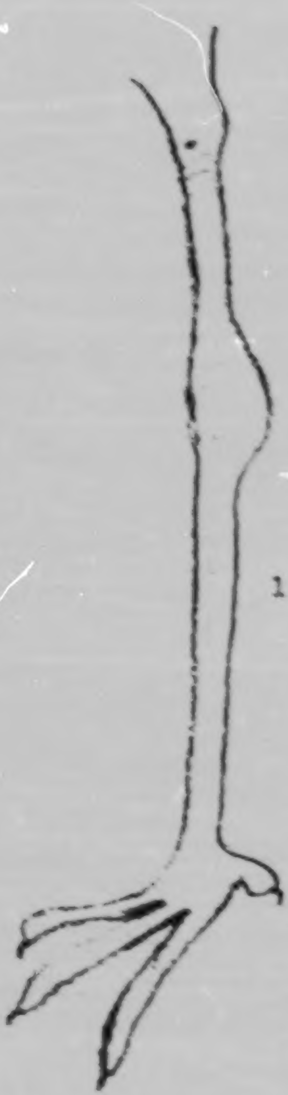
3. Foot of a predatory bird. The foot is very muscular and has well-developed claws for holding prey. The claws are also very sharp and adapted for tearing material apart.

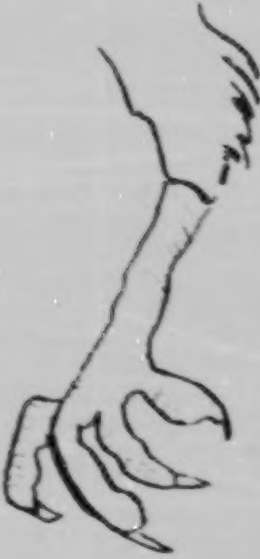
4. Foot of a bird living in snow covered region. Note, the feathers are used to help support the weight as well as keep the foot warm.

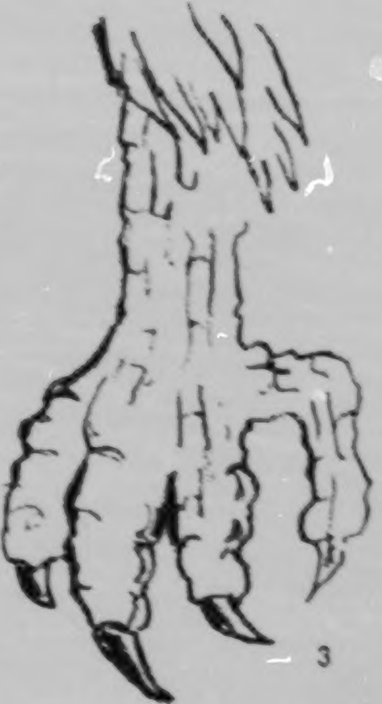
5. Foot of a water bird. Note the web between the toes. When toes are spread, the foot acts as a paddle or oar.

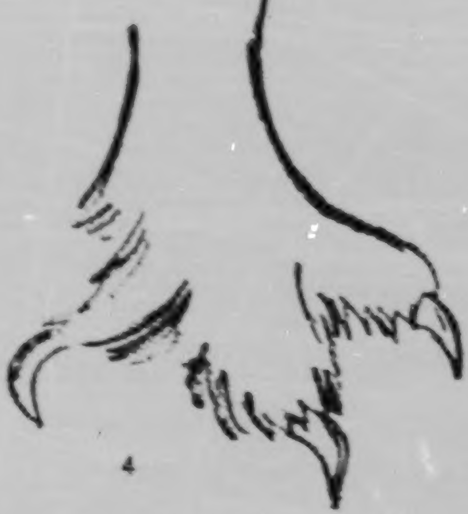
ADAPTATION

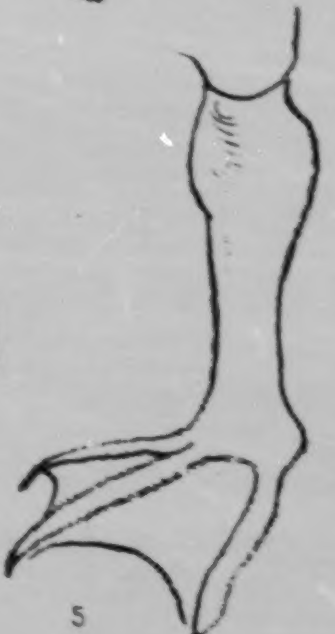
WHAT TYPE OF AREA, OR HABITAT, WOULD YOU EXPECT TO FIND A BIRD WITH EACH OF THE FOLLOWING TYPE OF FEET?


1


2


3


4


5

ADAPTATION

For teacher reference when using the bird beak diagrams.

1. Beak of a predatory bird. Note the hooked end used for grasping, and the apparent strength of the beak.

2. Beak of insect and grain eater. Not a highly specialized beak. This bird beak is used for eating only those foods requiring little or no breaking before swallowing.

3. Beak of a grain eating bird. Note the short, stout structure. Well adapted for cracking various grains.

4. Beak of a nectar eating bird. Note the long, tubelike structure. Adapted for reaching into large flowers. Nectar is sucked up through the beak.

5. Beak used nearly the same as number three.

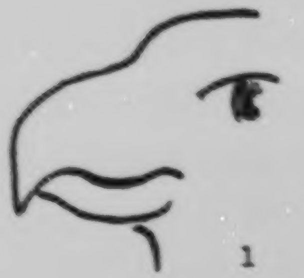
6. Beak used for drilling into wood. The beak is sharp pointed, stout, and reasonably long for reaching insects and larva under tree bark.

7. Large fishing bird beak. Adapted for capturing and collecting larger fish. Beak opens wide and fish can be collected in the pouch under the beak.

8. Beak of a bottom feeding water bird. Beak is wide and used as a shovel. When the mouth closes, excess water squirts out the sides, then food can be swallowed.

ADAPTATION

WHAT KIND OF FOOD DO YOU THINK A BIRD WITH EACH OF THESE TYPES OF BILL WOULD EAT?



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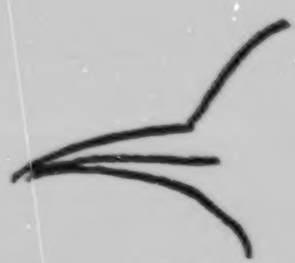

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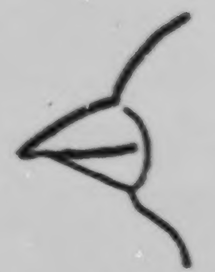

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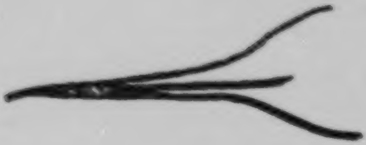

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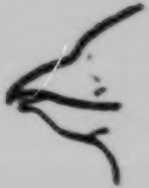

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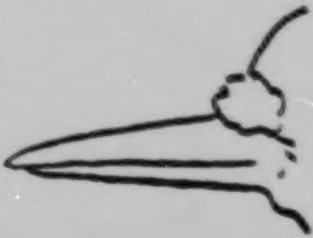

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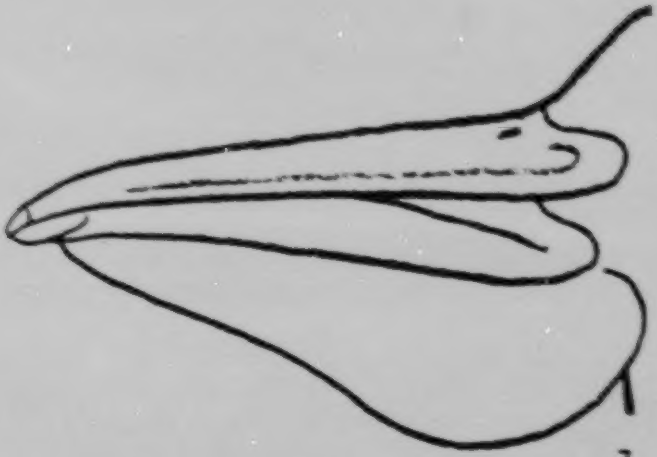

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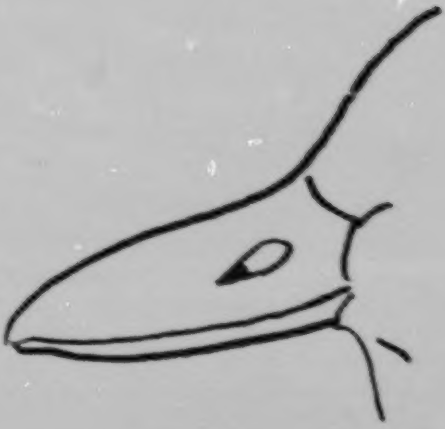


8

Questions for Parasite Life Cycles

(See B-16 and B-17)

The Beef Tapeworm -

1) How many hosts does the beef tapeworm depend on? (man and beef)
2) How can we control the beef tapeworm? (properly disposing of human waste, properly cooking the beef we eat)
3) What harm does the beef tapeworm cause? (takes part of man's food supply; can, in extreme cases, block the intestine; can weaken the cattle if highly infected)

The Sheep Liver Fluke -

1) How many hosts does the sheep liver fluke depend on? (sheep, snail, and water plants)
2) How can we control the sheep liver fluke? (do not let sheep excrete body waste into the water supply, remove the snails from the water supply, remove the plants from the water supply)

The Dog Tapeworm -

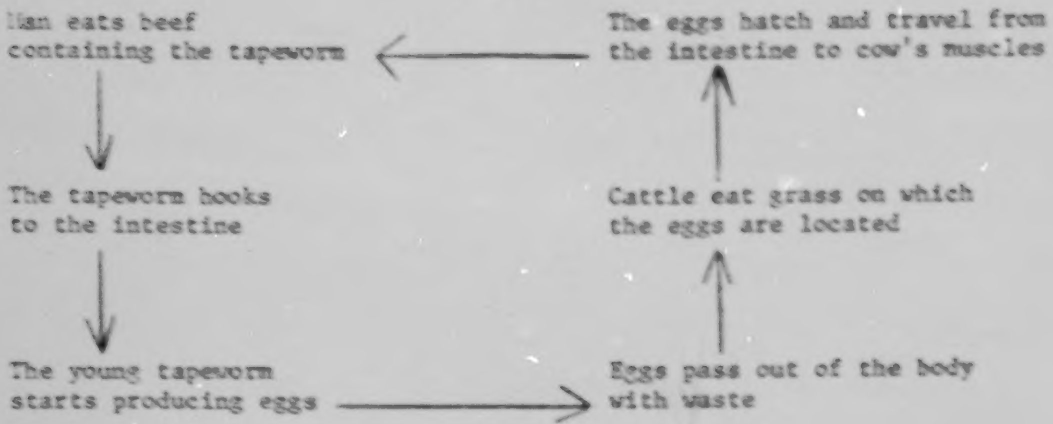
1) How many hosts does the dog tapeworm depend on? (dog and fleas)
2) How can we control the dog tapeworm? (keep the fleas away from the dog so he will not be nipping at and eating the fleas)
3) How can man keep from getting the dog tapeworm? (eliminate fleas around the cats and dogs)
4) Is the flea a host or a parasite? (the flea is a host to the tapeworm and a parasite to the dog)

The Hookworm -

1) How many hosts does the hookworm depend on? (man and vegetation)
2) How can we control the hookworm? (proper disposal of body waste, wear clothes and shoes to prevent the young hoodworm from attaching)
3) Would you expect hookworm in northern United States? (no, the eggs would freeze during the winter)

Parasite Life Cycles

THE BEEF TAPEWORM



Man eats beef containing the tapeworm

The tapeworm hooks to the intestine

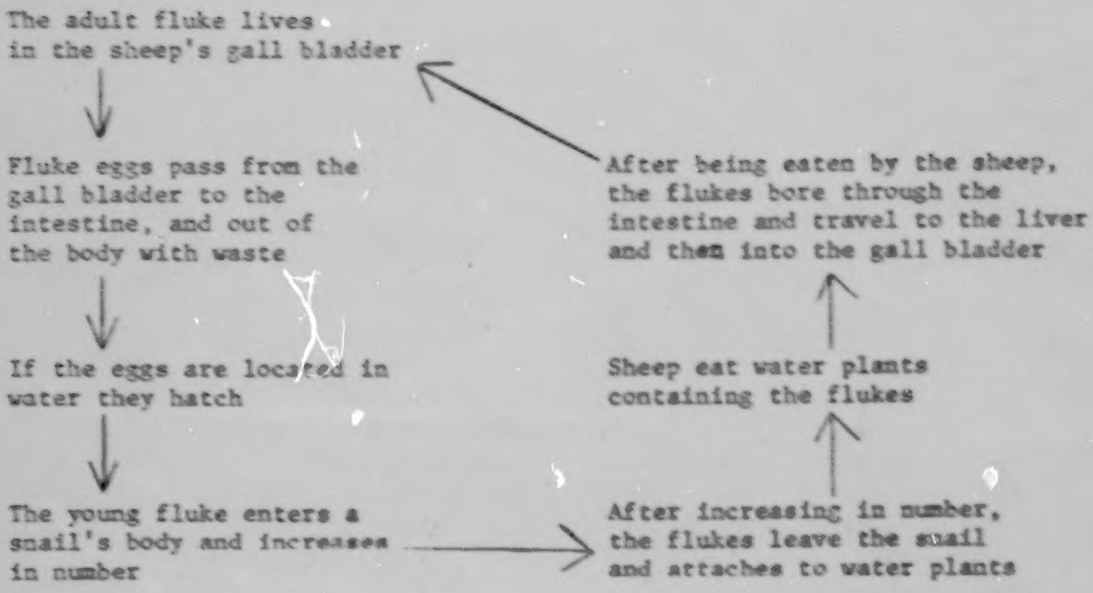
The young tapeworm starts producing eggs

Eggs pass out of the body with waste

Cattle eat grass on which the eggs are located

The eggs hatch and travel from the intestine to cow's muscles

THE SHEEP LIVER FLUKE



The adult fluke lives in the sheep's gall bladder

Fluke eggs pass from the gall bladder to the intestine, and out of the body with waste

If the eggs are located in water they hatch

The young fluke enters a snail's body and increases in number

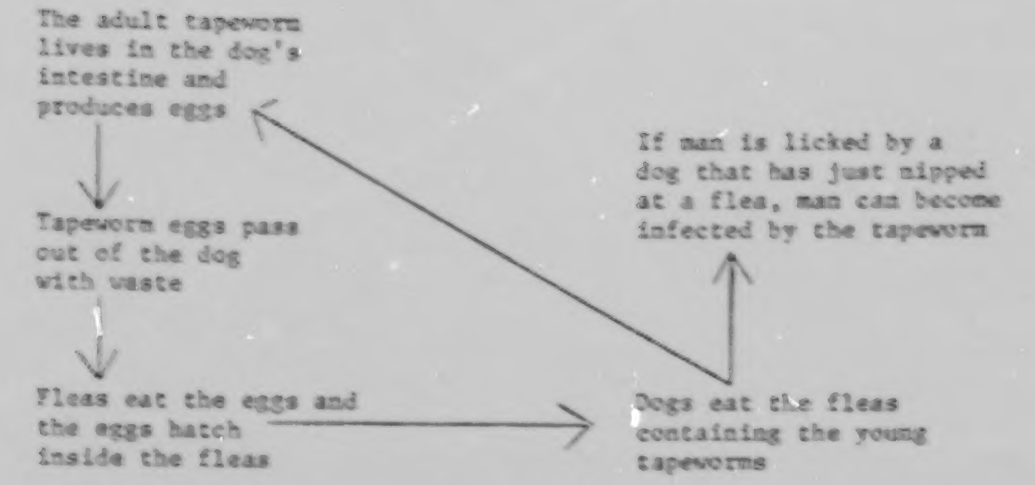
After increasing in number, the flukes leave the snail and attaches to water plants

Sheep eat water plants containing the flukes

After being eaten by the sheep, the flukes bore through the intestine and travel to the liver and then into the gall bladder

Parasite Life Cycles

THE DOG TAPEWORM



The adult tapeworm lives in the dog's intestine and produces eggs

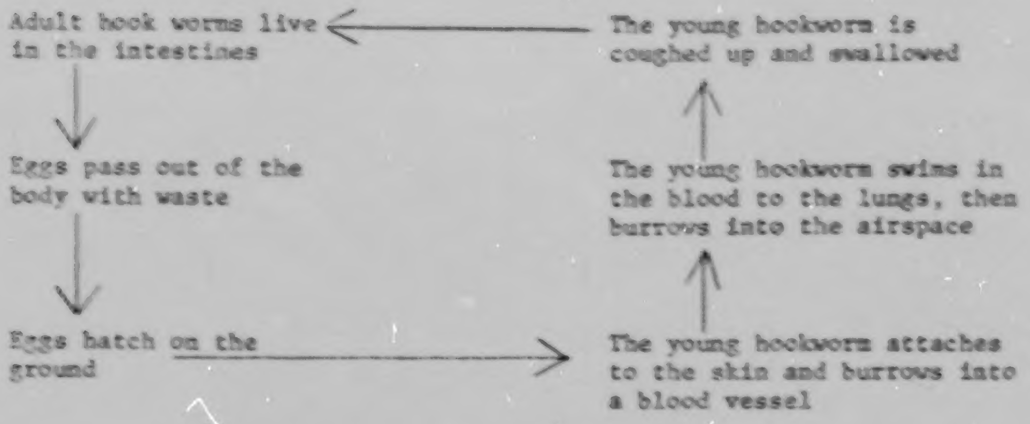
Tapeworm eggs pass out of the dog with waste

Fleas eat the eggs and the eggs hatch inside the fleas

Dogs eat the fleas containing the young tapeworms

If man is licked by a dog that has just nipped at a flea, man can become infected by the tapeworm

THE HOOKWORM



Adult hook worms live in the intestines

Eggs pass out of the body with waste

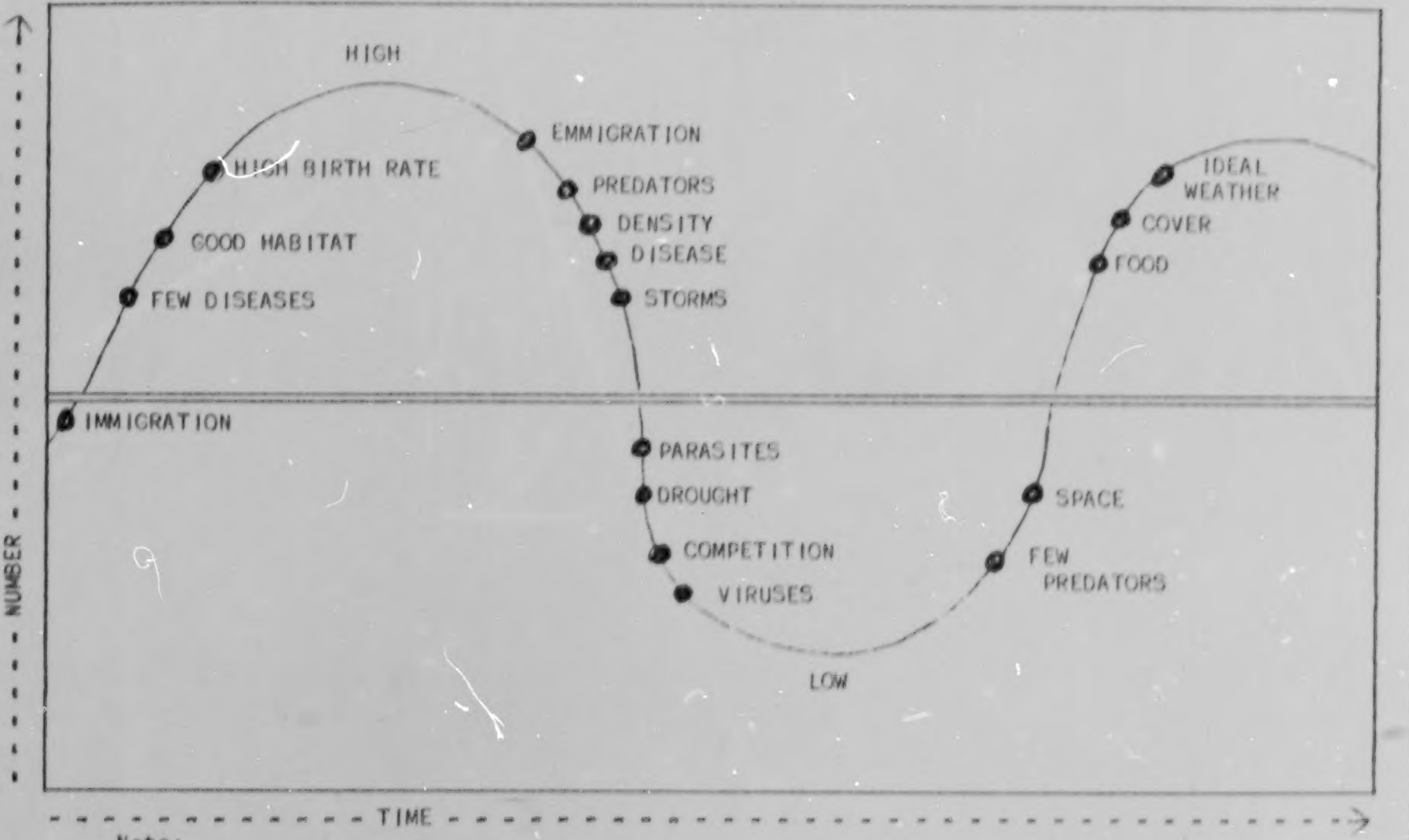
Eggs hatch on the ground

The young hookworm attaches to the skin and burrows into a blood vessel

The young hookworm swims in the blood to the lungs, then burrows into the airspace

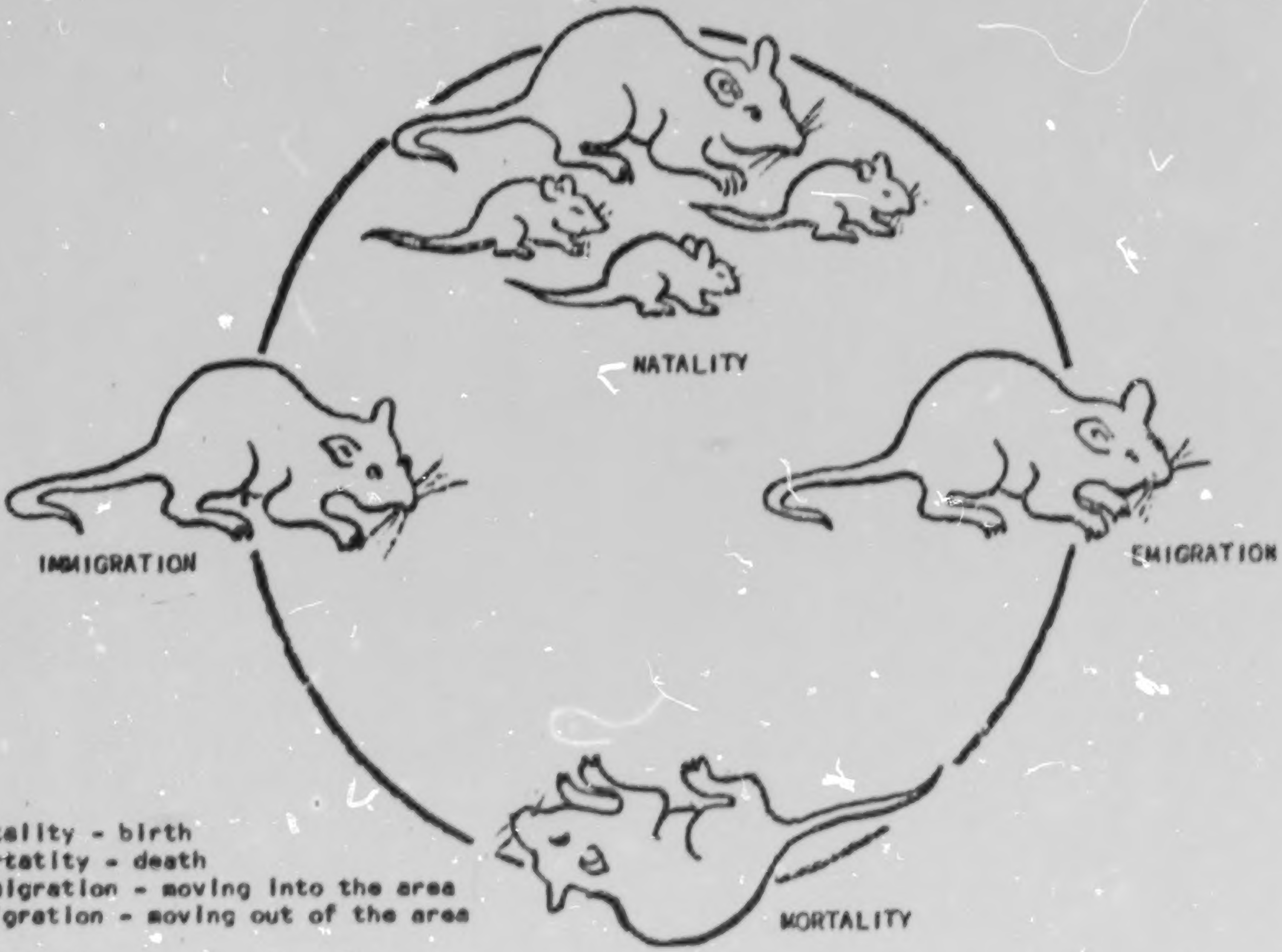
The young hookworm is coughed up and swallowed

POPULATION CYCLE


HIGH
HIGH BIRTH RATE
GOOD HABITAT
FEW DISEASES
IMMIGRATION
EMMIGRATION
PREDATORS
DENSITY
DISEASE
STORMS
PARASITES
DROUGHT
COMPETITION
VIRUSES
LOW
FEW PREDATORS
SPACE
FOOD
COVER
IDEAL WEATHER
NUMBER
TIME

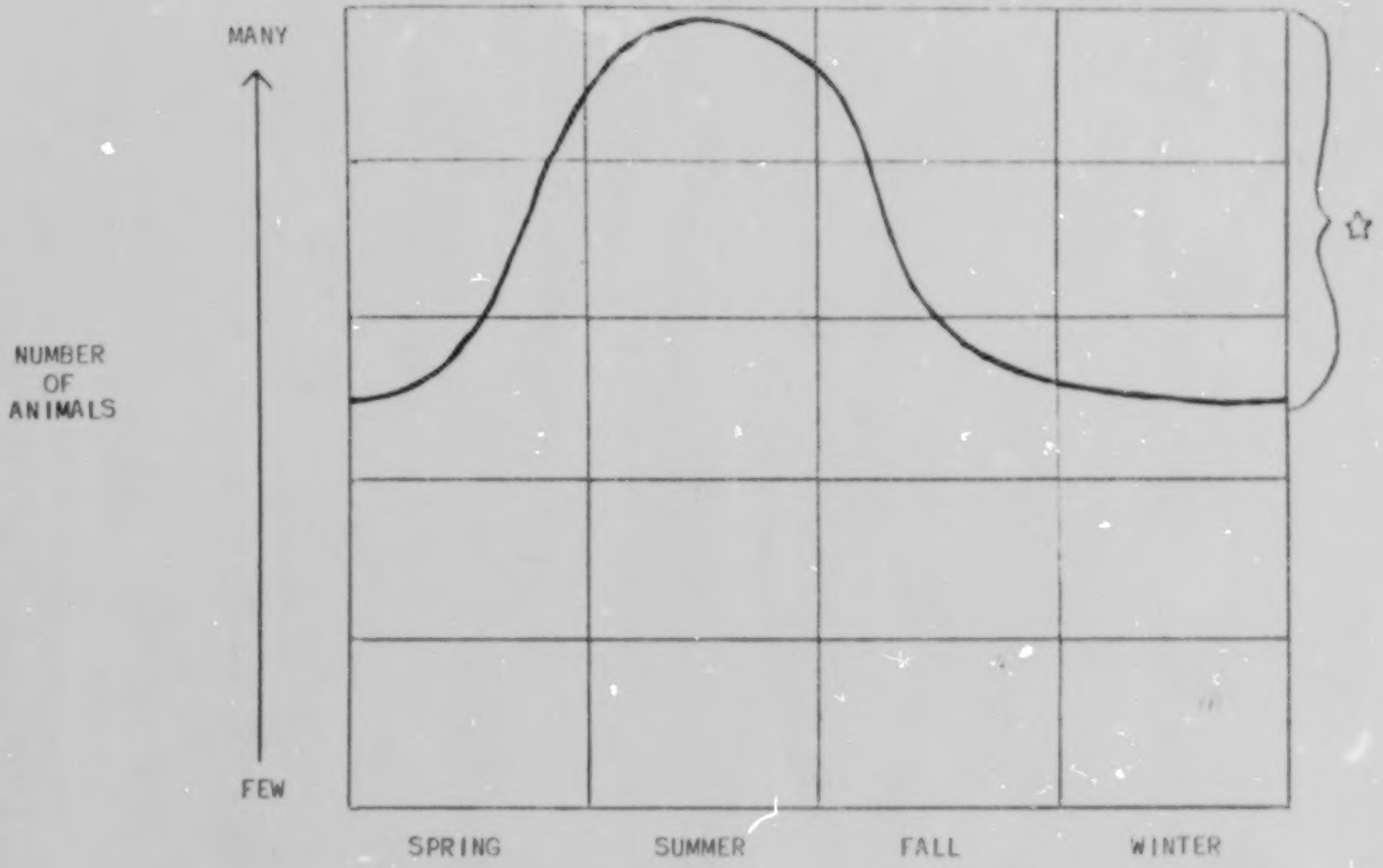
Note:
Factors on rising portion of the curve cause an increase in a population.
Factors on the falling portions of the curve cause a decrease in a population.

FACTORS CONTROLLING A POPULATION


NATALITY
IMMIGRATION
EMIGRATION
MORTALITY

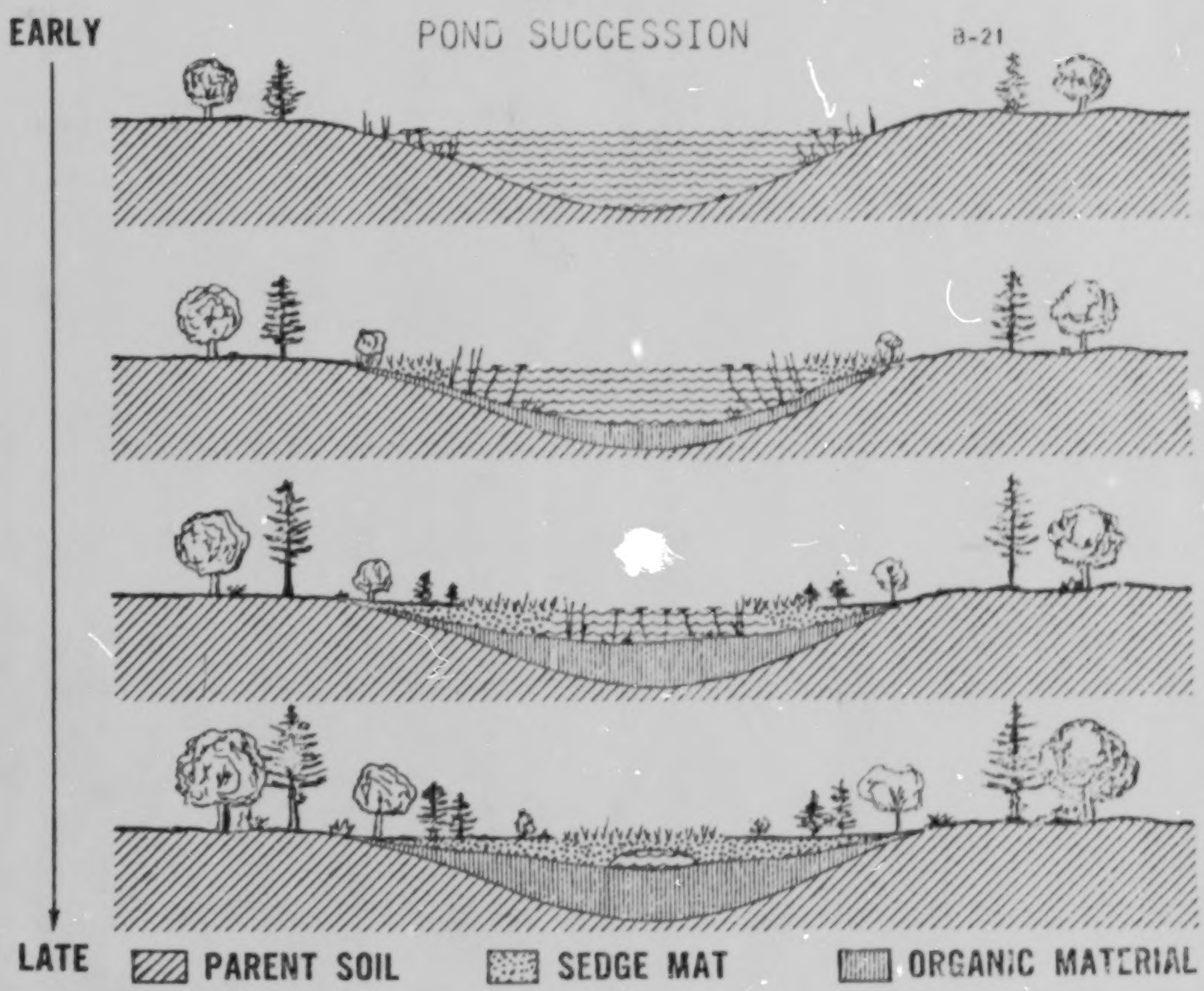
Natality - birth
Mortatity - death
Immigration - moving into the area
Emigration - moving out of the area

CARRYING CAPACITY OF HABITAT



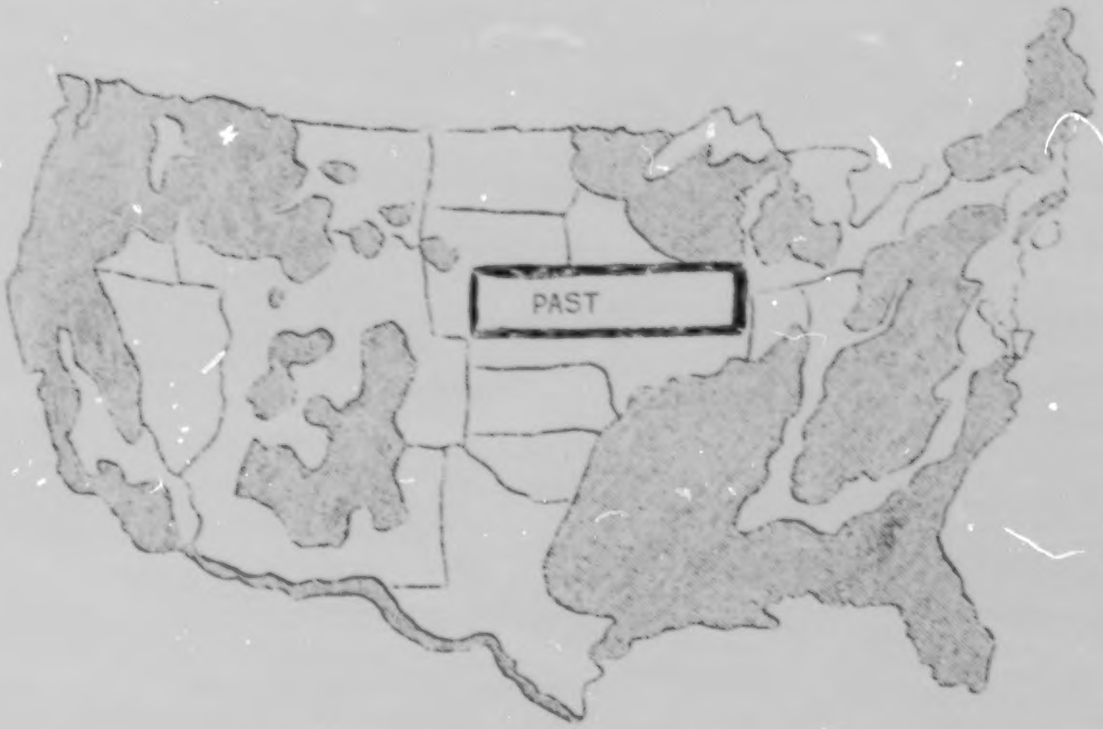
☆ Note: Those animals that normally die within a year. The wildlife game bag limits are based on the difference in the summer population and the winter carrying capacity of the habitat.

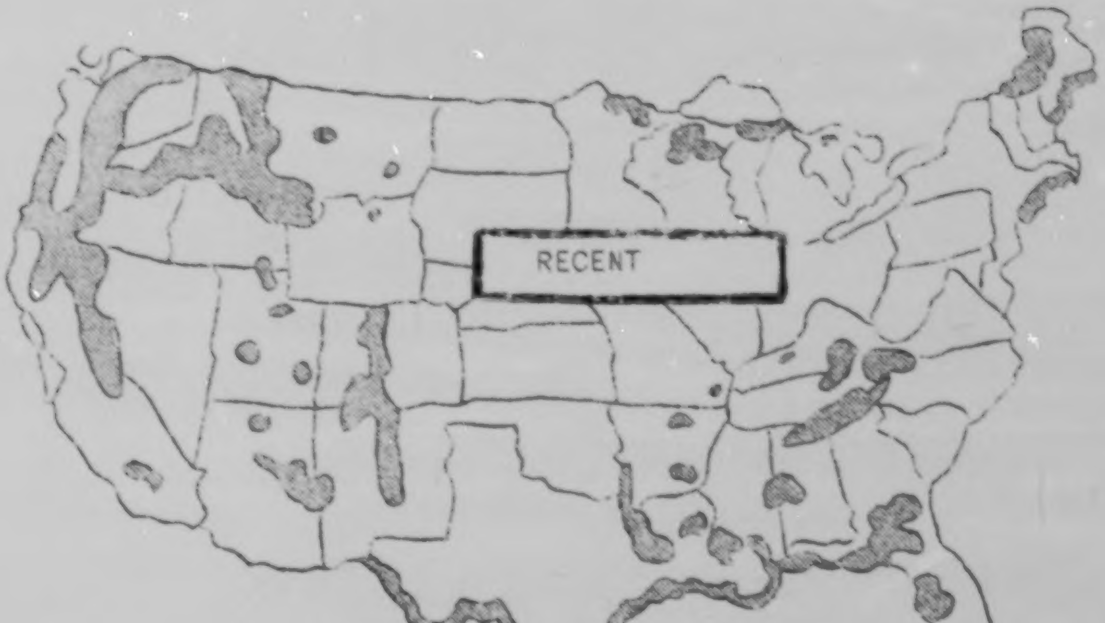
POND SUCCESSION


EARLY
LATE
▨ PARENT SOIL
▒ SEDGE MAT
▥ ORGANIC MATERIAL

U. S. VIRGIN FOREST

Change over
100 years





APPENDIX C

Student Study Guides and Handouts

The following guide sheets and handouts are provided as samples for directing students' attention during various activities. Teachers should feel free to modify the material included in any way they feel would be helpful. Student copies can be made from the sheets by using Thermal Spirit Masters.

Organism Study Sheet
(for use before doing the food web exercise). . . . . .C- 2

Food Web Stories and Pictures
(for use following the food web exercise) . . . . .C- 3

Sound Observation Sheet
(for use on the school ground or local park). . . . . .C- 8

Student Observation Sheet
(for use on the school ground or local park). C-10

Property Bingo
(for use on the school ground). C-11

Quadrat Study Recording Sheet
(for use on the school ground or local park). C-12

Plant Observation Chart
(for use in the classroom). C-13

Animal Observation Chart
(for use in the classroom). C-14

Personal Data Sheet
(for use in the classroom). C-15

Graph Paper
(for use with personal data sheet
and population graphing). C-16

ORGANISM STUDY SHEET

NAME____________________________________ DATE__________________

Name of plant or animal (organism)____

1) Where does the plant or animal live? (grassland, forest, ocean, lake, rivers, desert, etc.)

2) In what countries or parts of the world can it be found?

3) What kinds of food does it eat, or how does it produce food?

4) Where does it find its food (on trees, underground, in the water), or what does it need in order to make food?

5) How does it protect itself?

6) How does it move, if it does?

7) Does it affect other organisms? If so, how?

8) Does man use this organism? If so, how?

9) Does man's activities or use of the environment affect this organism?

10) What are some unique things about this organism?

11) How many new organisms can one adult produce?

FOOD WEB STORIES

1) Some evening you will hear the lovely weird call of the screech owl in that tree by the garden wall. Encourage him and his mate to stay about. They will sometimes make a home in a bird box. Screech owls do sometimes eat birds, but for the most part, their diet is insects, mice and other pesky animals. Many people think the screech owl is especially worthy of our protection.

2) Most praying mantis species came to us from Europe or the Orient, but they thrive here and should have many gardener friends. A savagely carnivorous insect, the praying mantis lives on grasshoppers and other insect. So valuable as an insect control is the mantis that its eggs are collected and sold to establish colonies in garden plots.

3) Another commercially prominent insect is the lady-bug or lady-beetle. On the Pacific Coast, lady-bugs are collected in vast numbers and distributed to crop areas at the rate of 30,000 lady-bugs for each ten acre tract. This is about one and one-fourth pounds of beetles, which does not seem like much. However, most kinds of lady-bugs live exclusively on such pests as plant lice, asparagus and potato beetles, grape-root worms, bean thrips, alfalfa weevils and chinch bugs. There are about 100 species of lady-bug in the United States, most of which are beneficial. However, a cousin across the Mexican border is a serious leaf-eating pest.

4) Higher up the ladder is the salamander - a good friend to your garden for his food is largely slugs, snails, worms, and other destructive creatures. Have no patience with those who claim that the salamander is poisonous in this country and should be exterminated.

5) Encourage the toads too. The gardener has no better friend! They live on such things as cut worms, potato beetles, chinch bugs, ants and slugs - unfortunately, sometimes on the helpful earthworm too, but other virtues outweigh this.

6) And don't misunderstand the skunk. Unless you disturb him he will keep out of your way, and he is extremely useful in the garden. More than 40 percent of a skunk's food consists of insects (potato beetles, hop miners, and grubs). He is also fond of mice, turtle eggs, carrion, and other waste. When deodorized, skunks make intelligent and playful pets. But don't leave the hen house door open at night!

7) Many people shudder at the name of snakes. But from the landowner's standpoint, there are a great many highly valuable species that are harmless and like to live in places such as your garden wall and prey on insects and rodents. Green and Black snakes are both helpful and harmless. Milk snakes are particularly useful in rodent control, and although harmless, are sometimes mistaken for a Copperhead. They do not seek cow-barns for the purpose of filching milk, but because they can usually find rats and mice around the feed-bins.

8) Red-wing blackbirds will be here by June and as much as one-fourth of their diet may be weevils. Red-wings are "valuable birds in spite of their reputation." While 74 percent of their food consists of vegetable matter, most of this is ragweed, smartweed, and other weed seeds. Only an eighth of the red-wing's total food consumption is valuable grain, the balance being noxious seeds and insects.

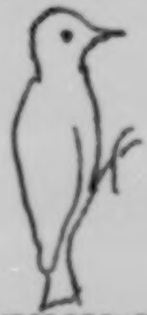
9) In the barberry hedge or the forsythia planting nests the shy brown thrasher. This lovely cousin of the catbird and the mocking bird is sometimes called the "mocking-bird of the North," and has been said on occasion to sing all day in spite of the rain. He still finds time though to cut down ruthlessly on caterpillars, grasshoppers, bugs, and beetles. While the thrasher has an unfortunate taste for berries, grapes, and currants, most folks think his good points outweigh the bad.

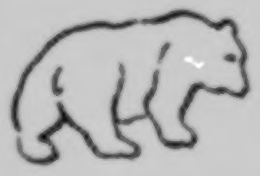
10) All day on seemingly tireless wings, swallows and martins patrol the air for flying insects. Flies of various kinds form some 40 percent of the barn swallows' diet, but in one instance around 1,000 leaf hoppers were found in a single swallow's crop. What a bird he was! Swallows and martins are gregarious, and nothing in your garden can be more charming nor useful than a martin house.

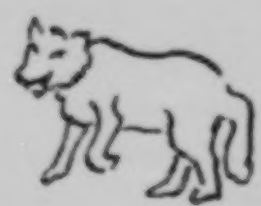
11) There on the fence post sits the meadowlark - nobody with quite that same charm. Besides his lovely song, he has an endearing way with crickets and grasshoppers. They form 25 percent of his food. One bird's stomach contained parts of 37 grasshoppers. Meadowlarks also have a weakness for your cutworms and white grubs.

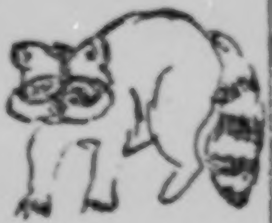
12) Some animals, such as rodents, deer, cattle, and certain insects, are strictly plant eaters. Others, such as the raccoon, that feasts on wild berries and also catches crayfish in the creek, feed upon both plant and animal matter. Other animals, the ones we call "predators," feed almost entirely on other animals. The fox eats the rabbit that eats the clover. The owl dines on the mouse that eats the grain. This food relationship is called a "food chain."

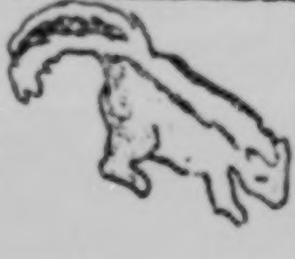
PICTURES FOR USE WITH FOOD WEB STORIES

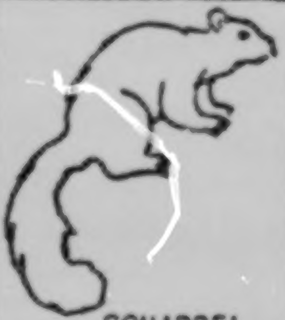

WOODPECKER

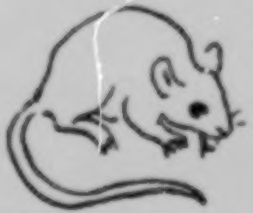

BEAR

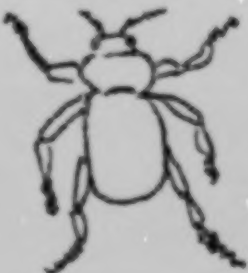

WOLF

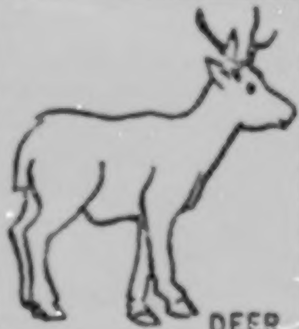

RACCOON

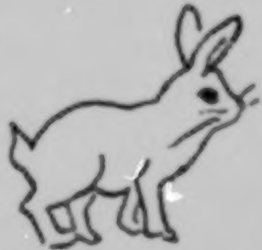

SKUNK

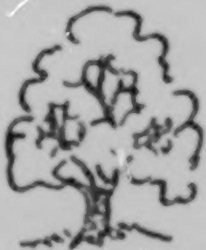

SQUIRREL

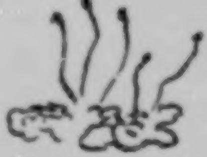

MOUSE

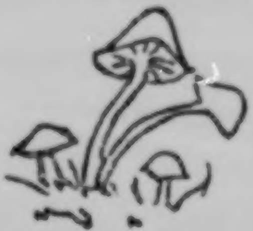

BARK BEETLE

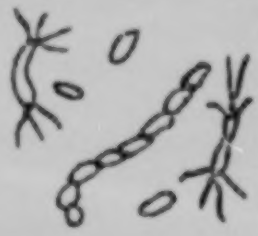

DEER

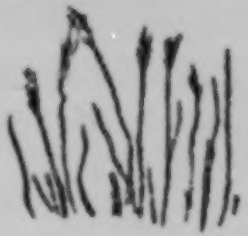

RABBIT

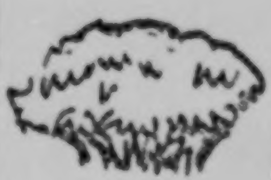

TREE

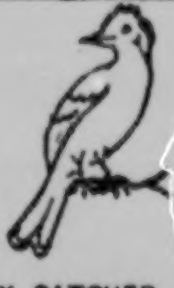

MOSS

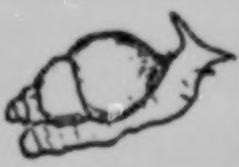

FUNGI

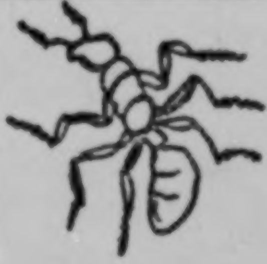

BACTERIA MOLDS

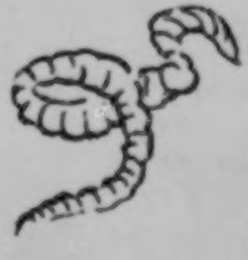

GRASS


SHRUBS

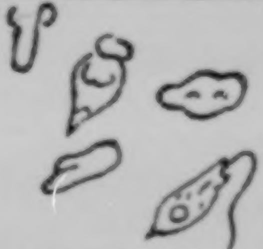

FLY CATCHER

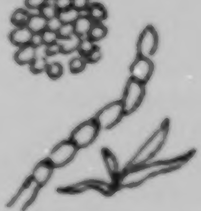

SNAIL

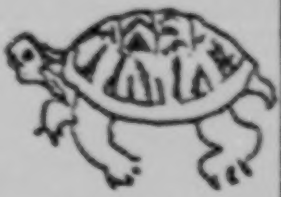

ANT

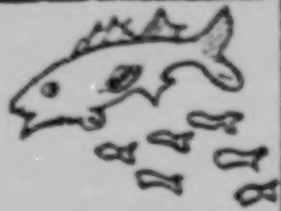

EARTHWORM

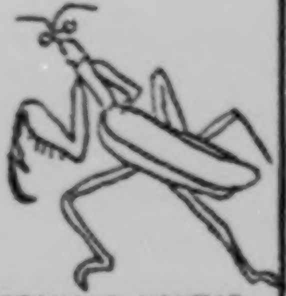
PICTURES FOR USE WITH FOOD WEB STORIES (cont'd)

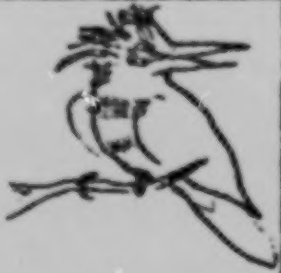

(ANIMALS)
PROTOZOA

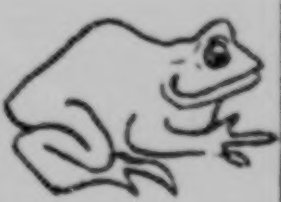

ALGAE
(PLANTS)

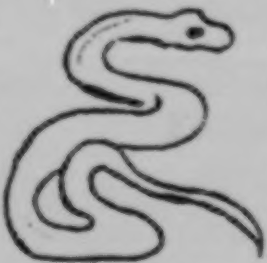

TURTLE

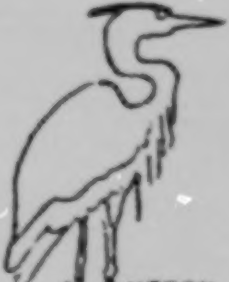

FISH


PRAYING MANTIS


KING FISHER


FROG


WATER SNAKE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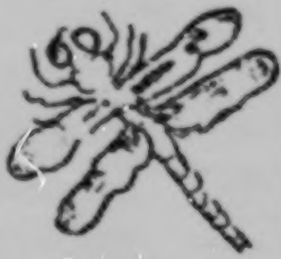
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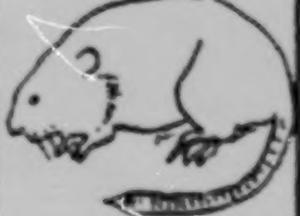
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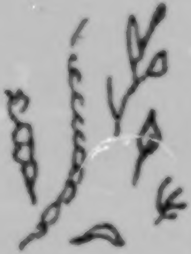
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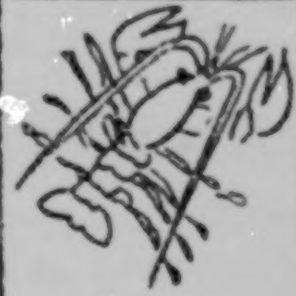
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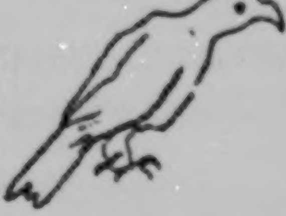
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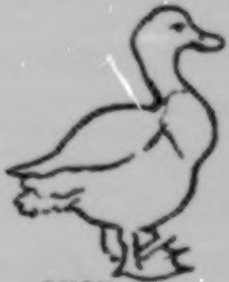
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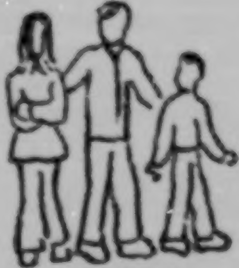
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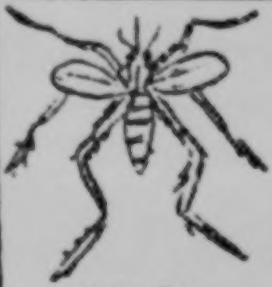
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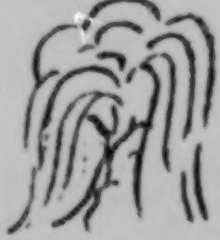
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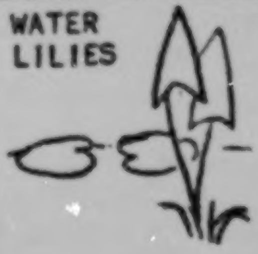
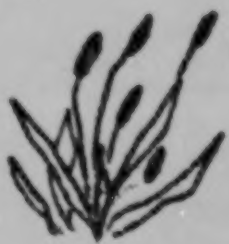
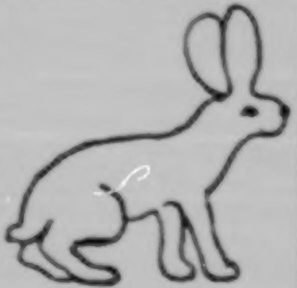

WATER LILIES

ARROW HEAD


CATTAILS

PICTURES FOR USE WITH FOOD WEB STORIES (cont'd)

C-7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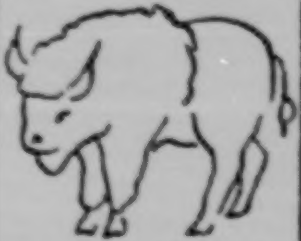
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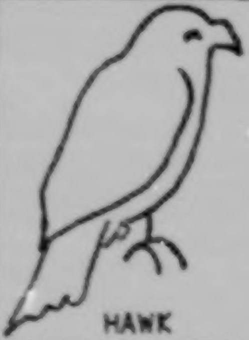
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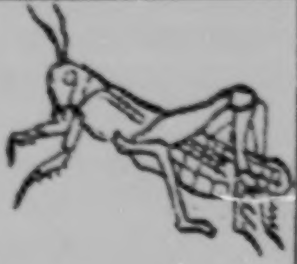
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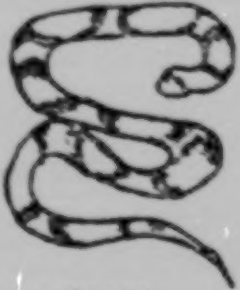
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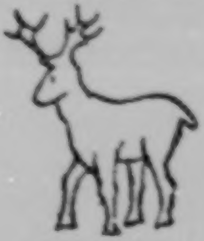
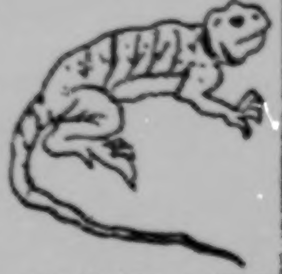
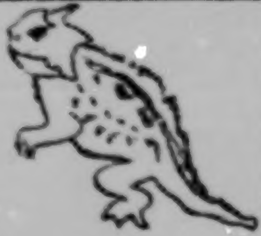
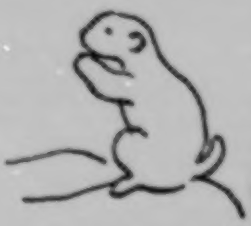
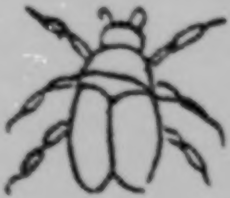
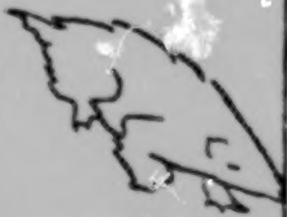

PRONGED HORNED ANTELOPE


COLLARED LIZARD


HORNED TOAD LIZARD


PRAIRIE DOG


DUNG BEETLE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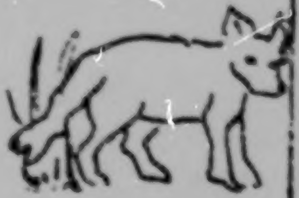
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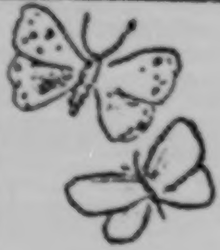
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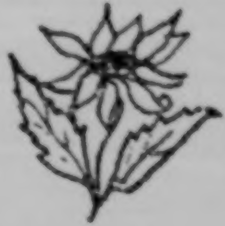
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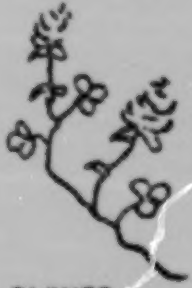
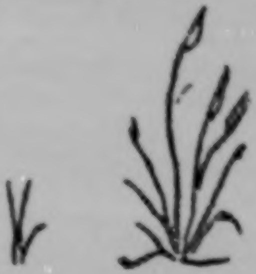
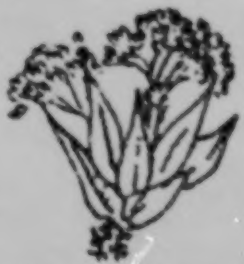
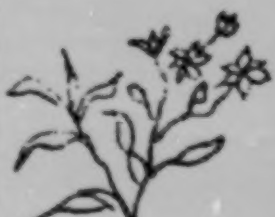
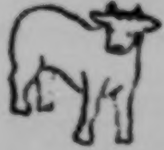
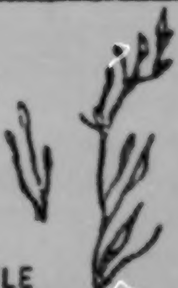

CLOVER


BUFFALO GRASS


BUTTERFLY WEED


DAISY


COW


LITTLE BLUE STEM

SOUND OBSERVATION SHEET

C-8

Name____ DATE____________________

1. How many different man-made sounds do you hear?

2. What do you think is producing the man-made sounds?

3. How many different sounds do you hear that are made by nature? (not man-made)

4. Are any of the natural sounds made by living organisms? What are the organisms producing the sound?

5. Are any of the natural sounds made by non-living things? What are the non-living things producing the sounds?

6. Where were the loud sounds coming from?

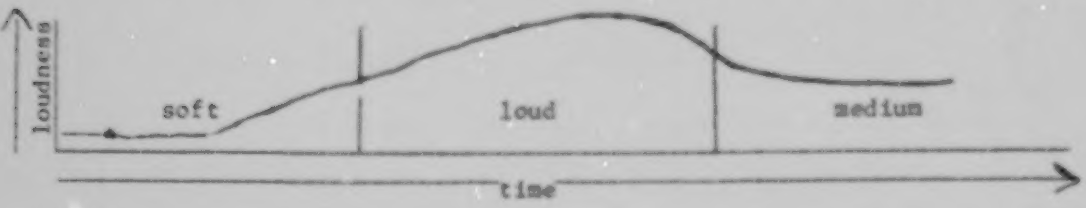
7. Where were the soft sounds coming from?

8. Did any of the sounds have rhythm or produce sound patterns?

9. Did you see anything that you could not hear a sound coming from?

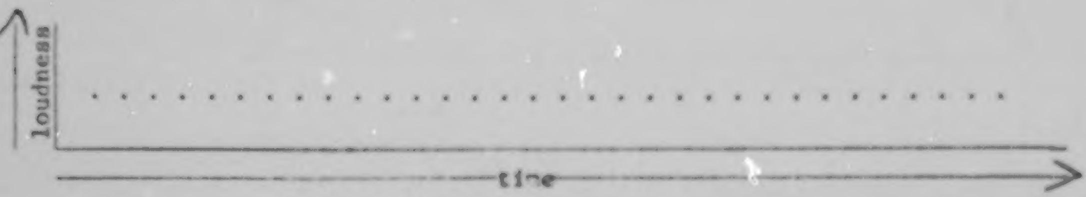
10. Sketch the pattern of several sounds, using a line, dots, or dashes. Below are three examples of sound patterns.

Example 1. A constant sound that varies from soft to loud to a medium volume.

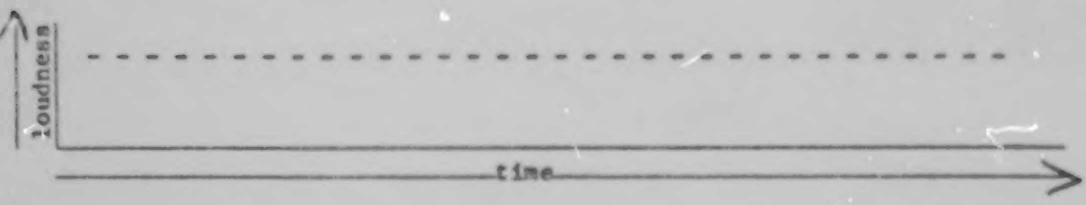


*The line represents the sound.

Example 2. A sound like hammering, all sound the same loudness.

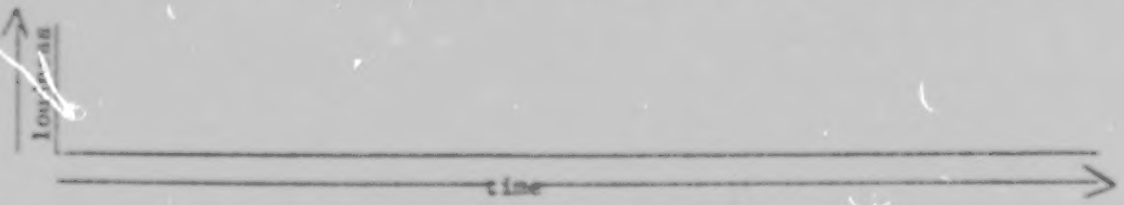


Example 3. Sounds that last short periods, but then repeat, same loudness.

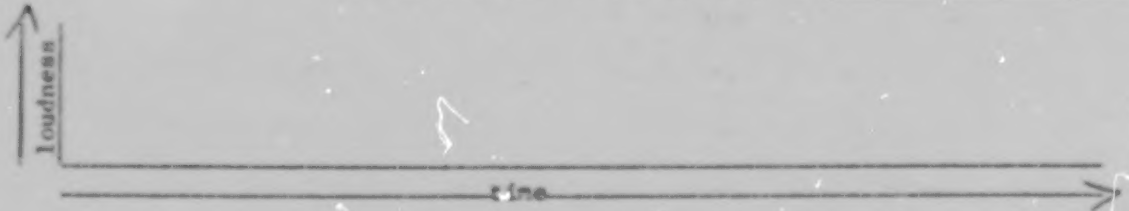


Use the following spaces to sketch sounds you hear. Use dots, dashes, and lines in any combinations you need to illustrate the sounds you hear. Be sure to go higher or lower on your sketch to illustrate loudness. How many different patterns can you illustrate?

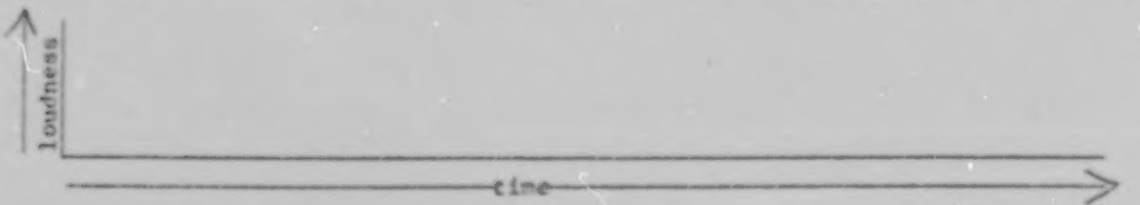
Sample 1. What do you think made this sound?____________________



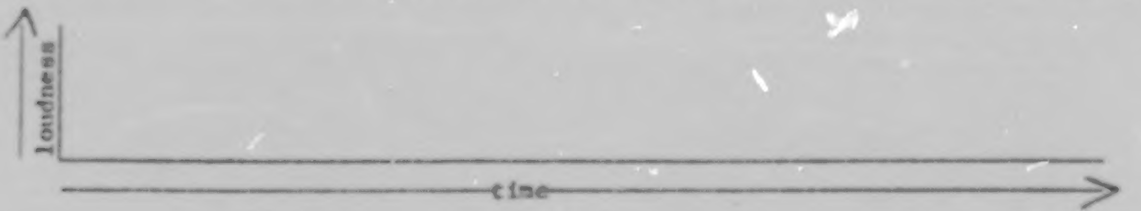
Sample 2. What do you think made this sound?____________________



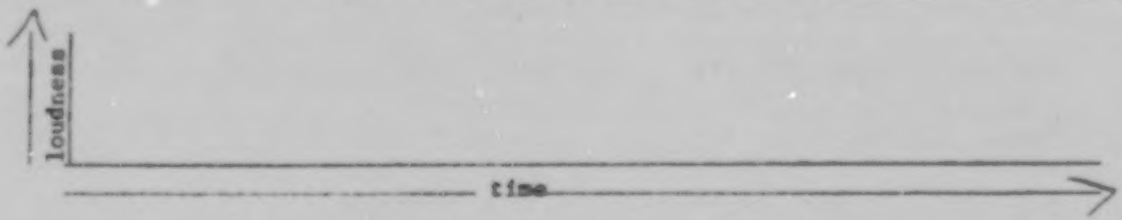
Sample 3. What do you think made this sound?____________________



Sample 4. What do you think made this sound?____________________



Sample 5. What do you think made this sound?____________________



STUDENT OBSERVATION SHEET

Use for short trips around school ground

NAME ______________________________ DATE ______________

Conditions That Change With The Seasons	Factors That Are Always Present Regardless Of The Season
Example: Seed Germination	Example: Air

Record one observational example for each:

Smell ____________________

Sound ____________________

Feel ____________________

Taste ____________________

Predator ____________________

Prey ____________________

Scavenger ____________________

Competition ____________________

Adaptation ____________________

Interaction ____________________

Change ____________________

Patterns ____________________

Food Chain ____________________

Producer ____________________

Consumers ____________________

____

Evidence of Decomposing ____________________

____

PROPERTY BINGO CARD

Smooth	Yellow	Fuzzy	Hard	Transparent
Flat	Wet	Rough	Breakable	Sharp
Manmade	Green	Rectangular	Sticky	Opaque
Smelly	Dry	Bendable	Soft	Juicy
Porous	Red	Oval	Stiff	Metallic

QUADRAT STUDY RECORDING SHEET

C-12

NAME______________________________ DATE______________

Location: Under a tree______ Open area______ Next to a bush______ Next to building______ (N) (S) (E) (W) Side of building______ School Ground______ Park______ Roadside______ Stream bank______ Other description______________
____

Weather: Sunny______ Cloudy______ Partly cloudy______ Rainy______ Sultry (humid)______ Hot______ Cool______ Warm______ Cold______ Windy______ Slight breeze______

Shade: Part of day______ Most of day______ All of day______ None______ What causes the shade?______________________________

Slope: Steep______ Slight______ Flat______ Direction of slope______________

Soil: Hard______ Soft______ Dry______ Moist______ Wet______ Soil warmer than air______ Soil cooler than air______ Same temperature______

Ground Cover: Type of decaying matter______________ Rocky______ Sandy______
Is the decaying ground cover: Thick______ Thin______

Plants:

	Number	Description
Example:	20	soft leaves, 12" tall, round stem, light green color

Animals:

	Number	Description
Example:	3	hard shell, six legs, hing legs long and with claws

Signs of animals not seen: Example: A big paw print with five toes. Animal waste
____
____
____

(Use the back of this sheet if more space is needed)

PLANT OBSERVATION CHART

Plant	Color(s)	Stem	Sketch Leaf Shape	Roots	Flower Size	Protective Structures	Other Characteristics

ANIMAL OBSERVATION CHART

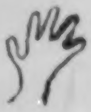
Animal	Color	No. Legs	No. Toes	Body Covering	Protective Structures	Food Gathering Structures	Tail	Other Characteristics

PERSONAL DATA SHEET

1. Height (to nearest inch)________

2. Weight (to nearest pound)________

3. Finger length, index finger (nearest 1/4 inch)________

4. Handspan  (nearest 1/2 inch)________

5. Eye level (to nearest inch)________

6. Long walking pace (to nearest inch)________

7. Arm length, fingers to shoulder (to nearest inch)________

8. Foot length, with shoes (to nearest inch)________

9. Fingers to fingers distance, arms outstretched (to nearest inch)________

10. Reach (height of fingers from floor when on tip toes) (to nearest inch)________

11. Eye color (circle the answer) blue, green, hazel, brown, gray

12. Hair color (circle the answer) black, brown, red, blonde

13. Circumference of waist (to nearest inch)________

APPENDIX D

Short Stories

The following short articles can be used either as reading for individual students, or for the entire class.

Classroom sets can be borrowed from the project office.

All the articles describe ways man has changed various environmental conditions.

The Life and Death of a Lake D-2

When Animals Turn Invaders D-5

New Central American Canal - Threat to Life D-9

Sticking Out Our Necks D-13

Wolves of Isle Royale D-16

THE LIFE AND DEATH OF A LAKE*

By James Silvan

Our growing population and increasingly technological society produce more and more waste material. Most of it ends up in the air or in water. This pollution threatens us and most other living creatures, including lakes. Lakes? Yes! For in a sense, lakes are living organisms. They have life cycles. They are created, they mature, and they die.

Lakes may arise when water is trapped in depressions formed in the shifting surface of the Earth. Such lakes are often long and narrow. Stratified rock can often be seen rearing up at an angle along one shore.

But not all long, narrow lakes arise this way. The famed Finger Lakes of New York State were created (along with the Great Lakes and many others) by the action of glaciers. As the huge ice masses moved across the continents, the ice scooped out large hollows. When the hollows filled with water as the ice disappeared, glacial lakes formed.

A lake begins to *mature* when it is invaded by plants growing around it. The plants on the edge die, fall over, and decay. They become part of the soil, which builds up higher and higher. As this process continues, the shoreline gradually moves out into what was previously deep water. What had been a marshy boundary of the lake becomes dry land.

In time, the entire lake is filled in. Often it becomes meadow land. Then bushes and finally trees become established where the water once was. When that happens, only a skilled geological detective is likely to know that a lake was ever there.

Some lakes are short-lived. Others last for thousands of years. In general, deep clear-water lakes that contain little nutrient material remain long after other lakes have disappeared. Examples of lakes poor in nutrients (*oligotrophic* lakes, from the Greek words meaning "little" and "nourishment") are the sparkling Lake Tahoe in California and Nevada, and the Finger Lakes in New York.

Lakes rich in nutrients (*eutrophic*, or "well-fed," lakes) are fairly common. One example is Lake Mendota in Wisconsin. Such a "well-fed" condition sometimes represents the "old age" of a formerly oligotrophic lake. The clear water may be gradually enriched by soil that erodes and washes into the lake. The soil minerals then support a rich growth of algae and other water plants, just as well-fertilized soil leads to the growth of an abundance of plants in a field. The growth of aquatic and semiaquatic plants eventually leads to the lake's drying up as soil builds up around its edges.

Under natural conditions, a lake is likely to remain clear and "young" for many centuries. But what happens when the wastes of great cities are emptied into a lake (or into a river that flows into the lake)? If human wastes are used as agricultural fertilizers in fields (a common practice in many parts of the world), the fields are often made highly productive. Similarly, if human wastes are emptied into a lake, the lake becomes highly productive.

**Science World*, October 25, 1968, pages 12-14.

ALGAE "CROP"

In this case, the "crop" consists of algae. As a result of the bountiful growth of microscopic single-celled algae, the water usually turns green, yellow, or blue-green. Hairlike strands of filamentous algae (such as the familiar Spirogyra) may appear in such abundance that the shallow water near shore turns into a mass of slimy green.

The algae on the surface of the water cut off the light from those plants only a few inches below them. Without light, plants die, and soon these shaded algae begin to rot and sink. The decay process uses up much of the oxygen in the water.

Result: Fish, and many of the insects, crustaceans, and other creatures that thrive in clear-water lakes disappear. They are replaced by a few species of worms and other invertebrates that require little oxygen. A biologist can often estimate a lake's degree of contamination (and resulting lack of oxygen) merely from noting what animals he finds in the water.

Even large bodies of water can be "aged" by overwhelming pollution. For evidence, look at the Great Lakes. These huge lakes (which, together, make up the largest body of fresh water on Earth) probably remained more or less unchanged for about 7,000 years. Yet during the past 40 years, growing human populations have dumped so much waste material into the lakes that marked changes have been noted. Fishing has declined in all of the Great Lakes during this period, and many kinds of fish have virtually disappeared from lake waters.

About 1925, the once abundant lake herring decreased. It was replaced by the whitefish, which in turn disappeared, to be replaced about 1939 by the walleye and perch. About 1953, the walleye declined, leaving fish such as perch, carp, and eels--species that can survive low concentrations of oxygen, at least until they can reach water that contains more oxygen.

The red blood cells of these low-oxygen-tolerant fish often have a special kind of hemoglobin. This oxygen-capturing red pigment picks up oxygen dissolved in the water that circulates through the gills of the fish. In fish that can tolerate water with little oxygen, the hemoglobin picks up oxygen about nine times as readily as does the hemoglobin of other fish. Another characteristic of these fish is that they seem able to use oxygen from the air stored in their swim bladders. (Not all fish have oxygen in their swim bladders. In some species, the swim bladder is filled with almost pure nitrogen.)

Lake Superior, northernmost of the Great Lakes, is the least polluted. Lake Erie is the most polluted. Erie is a shallow lake, and several large cities--and large industries--dump wastes into it. Once it was a great commercial fishing lake. Its catches were equal to half the total catch of all the Great Lakes. But no more. Because it is shallow, and relatively small as well, it is especially sensitive to contamination.

Once-popular Lake Erie bathing beaches are now covered with masses of smelly, decaying material. Rivers polluted by booming industries sweep bacteria, detergents, insecticieds, oil, ammonia, cyanide, phenol and hydrogen sulfide (which smells like rotten eggs) into the lake. In fact, the rivers seem to bring almost everything but oxygen to the lake.

Although authorities claim that Lake Erie has a long time to go before it dies, they are working feverishly to solve what has become known as "the Lake Erie problem."

There is more life in Lake Erie than ever before, according to one authority. But much of it is the life of putrid waters. For fishermen, swimmers, boat owners, and lakefront property owners, Lake Erie seems a sad and dying lake.

What can be done to save Lake Erie--and the hundreds of other lakes that are threatened by civilization's ravages? Elaborate treatment of sewage and of industrial wastes have been proposed. But recently, the people who live around Lake Tahoe, which is still clear and sparkling, rejected this proposal. They want to keep their lake as it is. Treat waste water, they said--and then export it, don't dump it in the lake. The water will be used to irrigate fields in Nevada. So Lake Tahoe may be saved. But not all waste water can be "exported."

It seems that if the human population continues to grow, our lakes are doomed to rapid aging. How many generations will it take for grasslands and forests--and then concrete and asphalt--to replace the sparkling waters we still enjoy today?

Questions for "The Life and Death of a Lake"

1) What is the most important producer found in lakes?

2) What does algae need in order to grow?

3) What happens to the oxygen in the water as algae dies?

4) Describe the life cycle of a lake. Use sketches to illustrate the various stages. (formation, plant development, filling in, plant growth)

5) Where does most of our waste material end up after we no longer need it?

6) How does the nutrients available influence the length of life for a lake?

7) How does emptying waste into a lake cause an increased rate of aging?

8) Why has Lake Erie become the most polluted of the Great Lakes?

9) What type of fish can survive in water containing low amounts of oxygen?

10) What type of life is now found in Lake Erie?

11) How has pollution affected the recreation activities around Lake Erie?

12) Are decomposers found in the lakes?

13) What do the words "aquatic" and "semi-aquatic" refer to?

14) This article was written in 1968. Can you find any more recent information about the present condition of Lake Erie?

15) What affect has recent state and federal laws had on pollution within Lake Erie?

16) What stage (life cycle) is Perry Reservoir in compared to Lake Erie?

17) Will Perry Reservoir go through similar stages to those that Lake Erie has gone through?

18) What are some ways Perry Reservoir differs from Lake Erie? What are some ways in which Perry Reservoir is similar to Lake Erie?

WHEN ANIMALS TURN INVADER*

By John Speicher

Three thousand deadly invaders have landed in the United States! What's more, they reached our shores with the aid of scientists. Rounded up in Europe, the fierce army zoomed across the Atlantic in roaring jets. Who were the members of this army? And why were scientists in on the "plot"?

The "soldiers" were tiny wasps armed with potent stingers. And their mission was not to destroy our country, but to beautify it.

Under the watchful eye of U. S. Department of Agriculture scientist Dr. R. I. Sailer, researchers are breeding the wasps in captivity to multiply their numbers. Eventually, Dr. Sailer plans to turn loose millions of the winged "invaders" across the land.

Why? Researcher Sailer is banking on the imported wasp to rescue this country's sick and dying elm trees. These tall, graceful trees once decorated thousands of U. S. communities. But, as you probably know, the beautiful trees are being wiped out at a terrible rate.

The cause: a devastating epidemic of Dutch elm disease. The disease is triggered by a fungus innocently carried by the elm bark beetle. Burrowing beneath the bark to lay its eggs, the female beetle "injects" spores of fungus into the tree. (The beetle picks up its cargo of spores as it flits from tree to tree in search of food.) Soon, the spores "sprout." Vast colonies of fungi spread like a cancer throughout the tree. Eventually, the growing fungi block the flow of sap in the tree--much as a blood clot might block the flow of blood in one of your arteries. The tree begins to wilt. Without flowing sap, the elm is a goner.

Enter the wasp. The European wasp (Dendroster) is a parasite in its larval stage. It is this characteristic that scientists hope to turn into a weapon against Dutch elm disease. How? Here's how a female Dendroster raises a family.

When ready to lay its eggs, the wasp buzzes around the bark of an elm tree, hunting for bark beetle larvae. When it locates a beetle larva, the female wasp thrusts its ovipositor (a tube through which the wasp lays its eggs) into the bark of the tree. Then the female wasp deposits an egg on or next to the beetle larva. When the wasp larva hatches, it feasts on the beetle larva, and kills it. By exterminating bark beetle populations, the wasp gives threatened elms a new lease on life.

Yet some scientists worry about the wasp. Suppose, they reason, that it wipes out the bark beetle population. Might it then switch over to the slaughter of helpful insects, such as those that keep other pests in check or pollinate farmers' fields?

Such worries are legitimate, say ecologists. Ecologists are scientists who investigate the relationships among living organisms in their environment. As the ecologists see it, all living things in a given environment form an inter-related community. And the scientists warn that introducing strangers into a natural community isn't always advisable--at least, not without careful consideration of possible consequences.

Indeed, plenty of evidence argues against bringing "intruders"--or introduced species--into the natural ecology of a region. One of the most dramatic examples of such a miscalculation greets the eye of any visitor to the Australian range land.

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*Science World, September 20, 1968, pages 4-7.

Back in the middle of the 19th century, Australia's colonists longed for some of the sports they'd enjoyed back in England, such as hunting European forms of wild game. Separated for countless millions of years from other land masses by ocean barriers, Australia lacked almost all the familiar game animals relished by European hunters. For instance, there were no native rabbits.

RABBIT PLAGUE

So settlers "down under" decided to import a few hundred rabbits. The rabbits came to a land in which they had no natural enemies. Multiplying rapidly, they competed with sheep for range-land. They drove away tens of thousands of little insect-eating marsupials called bandicoots. The bandicoots evacuated their homes--holes in the ground. And the rabbits claimed the predug lairs for themselves.

Within a decade or two, Australia was overrun by millions of European rabbits. Farming and the wool industry were endangered by the furry invaders who munched on every plant in sight. In 1887, a government reward of 25,000 pounds sterling (more than $100,000) was offered to anyone who devised a method of exterminating the intruding rabbits.

Almost a century passed. The rabbits kept increasing in number. By 1950, about half a billion of the animals infested Australia!

It was then that scientists elected to fight fire with fire. Since an introduced species was the root of the crisis, another kind of intruder might rescue the threatened land.

Biologists planned deliberately to introduce a virus disease into the rabbit population. The viral disorder, myxomatosis, was discovered to be lethal to European rabbits but to no other rabbits. Researchers found that American cottontails and Brazilian wild rabbits normally live with myxomatosis in their systems, suffering only mild symptoms such as benign (harmless) tumors.

By inoculating Australia's European rabbits with disease "germs" from Brazilian and American rabbits, scientists hoped to cause an epidemic among the 500-million-strong Australian rabbit population. In May, 1951, workers began trial tests. They trapped rabbits, inoculating them with myxomatosis, then shuttled them back to join their fellow rabbits in the wild. At year's end, rabbits were dropping dead all across the test area.

The program shifted into high gear. More and more rabbits were trapped, inoculated, and released to spread the disease to other rabbits with which they came in contact. Finally, after three years of disease-spreading, the Australian authorities conducted a rabbit census. Findings? Only an estimated 10 to 20 percent of the original half a billion rabbits had survived the plague introduced by man!

Since the mid 1950's, Australian authorities have continued this program, keeping the rabbit population as low as possible. But those of us outside Australia shouldn't feel smug about the 19th century rabbit blunder "down under."

Did you know, for instance, that in 1890 there wasn't a single starling in North America? Today, there are more starlings than people! The pesky birds deplete man's grain fields and mar city buildings with their droppings. They have even caused a tragic aircraft disaster by clogging up the engines of a jetliner in flight.

MONGOOSE TROUBLE

How did the starling get here? In the last decade of the 19th century, a wealthy bird-lover named Eugene Schiefflin imported 200 starlings from Europe. Why? He wanted to establish in New York City some of the birds about which he had read in Shakespeare's plays. Today, his 200 birds have multiplied a million-fold, inhabiting almost the entire nation. (Schiefflin also introduced the English house sparrow to America. There are now about 150 million of these birds in the U. S.)

Let's shift the scene to the West Indies, where mongooses were introduced from Africa to control snakes. Poultry farming is widespread in the West Indies. To the dismay of West Indians, the mongoose, once established in their land, switched its dietary tastes. While turning up its nose at snakes, it now makes many a hearty meal of chickens.

African land snails, introduced into Pacific islands by the Japanese, have also become an ecological headache. The snails were high on the menu of the Japanese. It turns out, though, that the snails are making more meals from man's garden vegetables than man is from snails.

Roaches in our cities, Japanese beetles in our rose gardens--the list of "animal intruders" is long indeed. The intruders often "go out of control" in new locales where they lack natural enemies, the "checks" of climate, and the competition of similar species.

Will the imported European wasp do likewise? The insect's "Friends" point out that North America already harbors several species of parasitic wasps, whose larvae feed on everything from crickets to caterpillars. Should the newcomer change its parasitic "preferences," they reason, it would behave much as do these native wasps--many of which now help control damaging insect pests. What actually will happen?

Probably, the verdict won't be in for many years. In the meantime, Department of Agriculture researchers hope to beautify our nation by restoring the once-glorious elm.

Discussion Questions for "When Animals Turn Invader"

1) How is the Dutch elm disease transmitted?

2) What organism actually causes the Dutch elm disease?

3) What is the suggested method for controlling the Dutch elm disease?

4) How does the Dutch elm disease affect the tree?

5) Why are some scientists concerned about the use of parasitic wasps to control the Dutch elm disease?

6) What happened when rabbits were introduced into Australia?

7) What allowed the rapid increase in rabbits? (Lack of natural controls)

8) How are the Australians controlling the rabbits?

9) How did starlings get into the U. S.?

10) What happened when the Mongoose was introduced into the West Indies to control snakes?

11) Name some other organisms introduced into new locations by man.

12) Why do animals often grow out of control when introduced into a new area?

13) Diagram several food chains discussed in this article.

14) List some predator-prey relationships that were discussed.

15) Were there any parasite-host relationships discussed?

16) Did any of the introduced species compete with native species? Give some examples.

NEW CENTRAL AMERICAN CANAL - THREAT TO LIFE?*

By Michael Cusack

Have you ever sailed "uphill" and then "downhill?" Travel by ship from New York to California, or vice versa, by way of the Panama Canal and you will go from sea level to 85 feet above sea level and back down again.

Wouldn't it be easier to sail straight through at sea level? Of course it would. Therefore, engineers are studying methods of building a sea-level canal across Central America. Such a canal would greatly benefit trade and defense. But, say naturalists, it may cost much more than money. It might cause the destruction of thousands of species of marine life.

Let's consider the limitations of the present canal, the need for a sea-level canal, and then we can plunge into the controversy.

If your ship enters the Panama Canal from the Caribbean side, it will take three giant "steps" up to sail on man-made Gatun Lake. After sailing across the lake and through narrow Gaillard Cut, a man-made passageway between high hills, the ship takes one step down to Miraflores Lake. Later, it descends two more steps to the sea level of the Pacific Ocean.

The "steps" of the Panama Canal are locks - huge concrete chambers in which the water level can be adjusted to life or lower ships. Passage through the locks is slow and difficult.

A ship passing through the canal is raised and lowered a total of six times. It takes over eight hours, not counting waiting time at the canal entrance, to complete the 50-mile trip. Since about 35 ships a day pass through the canal, there are frequent traffic jams.

But what alternative does a ship's captain have? The only other practical passage from the Atlantic to the Pacific is around stormy Cape Horn at the tip of South America. However, that would add 8,000 miles and several weeks to the trip.

As it is, many ships have no choice but to make the long stormy passage around the tip of South America - they are too big to squeeze through the present canal. The 1,000-foot-long, 110-foot-wide locks aren't big enough to take huge new aircraft carriers and supertankers. This limits one of the canal's main purposes - to serve as a vital link in the U. S. defense system. Though the canal has great commercial value, the U. S. originally took over the project primarily to provide a means of rapid passage for our warships.

DIGGING WITH ATOMIC BOMBS

Because of the limitations of the existing Panama Canal, a new Central American canal is being considered. Several sites are under study. Whatever site is selected, it is planned that the new canal will have no locks. It will flow from ocean to ocean at sea level. Thus, it can be enlarged as ships grow larger and traffic increases. At sea level all the way, passage through the new canal would be much faster than through the existing one.

The original Panama Canal was planned as a sea-level canal. But the overwhelming amount of rock and earth that would have had to have been dug up and carted away forced the engineers to redesign it as a lock canal.

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*Science World, January 10, 1969, pages 6-8.

Now, however, digging is no longer a major problem. We possess super digging tools --nuclear explosives. A huge long ditch can be formed by exploding a string of atomic bombs slightly under the ground. Such a ditch would be much wider and deeper than the present Panama Canal. Tests with nuclear explosives have shown that this is practical.

Carting away material wouldn't even be a problem: experiments with conventional explosives show that material from the ditch would pile up along its sides to form embankments. Very little thrown-out material would settle at the end of the ditch.

Radioactive fallout used to be considered a major problem. However, Dr. Glenn Seaborg, Chairman of the Atomic Energy Commission, has assured Congress that the use of relatively clean nuclear explosives (producing very little radioactive debris), and the depth of the explosion, would keep radioactivity below the hazardous level.

Very many engineers, scientists, planners, and politicians contend that we can now blast a sea-level canal across Central America at less cost and in much less time than it took to dig the present inadequate lock canal. And they are eager to start the project. They point out that the needs of national defense and international trade demand a new sea-level canal now.

However, the clamor for a sea-level canal is not unanimous. Several scientists oppose the project. They contend that such a canal might trigger an ecological disaster.

Dr. Ira Rubinoff, assistant director for marine biology at the Smithsonian Tropical Research Center, recently warned that a sea-level canal across Central America could threaten many forms of marine life. How?

For one thing, the waters of the Pacific in that area are colder than those of the Caribbean. Thus, the marine life of the two seas differs significantly. Given the direct path of a sea-level, salt-water canal, these different forms of marine life would migrate from sea to sea and intermingle. (The locks, and especially the fresh-water lakes of the present Panama Canal, prevent such marine life migrations.)

These marine life migrations would force changes in feeding and spawning (see Workshop). Many species would encounter new foes. New struggles for survival would begin.

Since an estimated 10,000 species would be involved, perhaps thousands of species might become extinct. And these critical losses could throw the area's ecosystem (relationship of living organisms to each other and to their environment) off balance.

We have records of this happening. Sea lampreys (a parasitic type of eel) invaded our Great Lakes by way of man-made canals. Because they found an abundance of lake trout and whitefish to feed upon, the parasitic lampreys thrived in the lakes. In time, they virtually destroyed all native lake trout and whitefish. This threw the lakes' ecosystems off balance. Trout and whitefish used to keep populations of smaller fishes in check. Thus, when the big fish disappeared, the lakes became choked with tiny fishes (which the lampreys don't eat).

Could a direct linking of the Caribbean and Pacific cause similar problems? In Dr. Rubinoff's opinion, we should expect such problems and on a much larger scale than anything previously encountered.

Despite his warnings and predictions, Dr. Rubinoff seems resigned to the coming of a sea-level canal. In fact, he seems to look forward to it as a large-scale biological experiment. He recently stated, "The sea-level canal can provide a unique opportunity to advance our scientific understanding of evolutionary and ecological processes."

GREATEST SPECIES EXTINCTION

Several naturalists strongly disagree with Dr. Rubinoff's position. They liken it to the attitude of a physician who would allow his patient to die because it would provide him with a grand opportunity to observe the process of dying. These dissenting naturalists don't consider the coming of a sea-level canal as inevitable. They believe that it can and should be resisted by the world's naturalists and conservationists.

Writing to the magazine Science, Dr. John C. Briggs, of the Department of Zoology of the University of South Florida, asked, "Should the sea-level canal project be undertaken at all? Are we prepared to assume the responsibility for the irrevocable destruction of several thousand unique species? Shall we, on the one hand, continue to expend public funds in an effort to save a few endangered species such as the whooping crane and tule elk, and, on the other hand, expend other public funds for a project that will result in the greatest extinction of species the world has ever seen?"

How would you answer Dr. Briggs' questions? Remember, a sea-level canal would unquestionably benefit international trade and bolster national defense. But at what price? No one has challenged the scientific conclusions of Dr. Rubinoff and Dr. Briggs that many marine life species will vanish when the warm waters of the Caribbean intermingle with the cold waters of the Eastern Pacific.

If we choose not to build a sea-level canal, what alternatives are available? The existing canal could be improved or another overland canal containing freshwater sections could be built. Either of these steps would save the species but would slow ship traffic and raise the chances of future traffic jams.

There's another point to consider. A lock canal can be easily disabled in wartime. A single bomb on a lock gate could cripple the entire canal. Yet, it would be very difficult to knock out a sea-level canal. Therefore, from a defense viewpoint, a sea-level canal is most desirable.

Questions for "New Central American Canal - Threat to Life?"

1) Why do some people want to make a bigger canal across Central America?

2) What is different between the present Panama Canal and the new proposed canal?

3) What type of questions are stopping the building of the new canal?

4) How is the new canal to be dug?

5) How will connecting the Pacific Ocean and Caribbean Sea affect life in either?

6) What stops animals from moving through the present Panama Canal?

7) Is the temperature of the Caribbean and the Pacific about the same? Why is this important?

8) Would new patterns of predator-prey relationships develop is the new canal was dug?

9) Why are we concerned if a species becomes extinct?

10) What did we learn as a result of lamprey entering the Great Lakes?

STICKING OUT OUR NECKS*

The Case for U. S. Giraffes

By Joan Schuman

As the blazing sun strikes their long necks, the giraffes lazily chomp on scraggy saltbushes and sagebrush. The members of the giraffe herd stick close together. Two female "guards" trot around the herd, watching for intruders. On the nearby hillsides, the first gentle slopes of the mightly Rocky Mountain range, herds of sheep and cattle graze on blue grama and buffalo grass.

Does this scene sound mixed-up to you? Can this be a western U. S. grassland? Yes--perhaps in the future. Combining the animals of an African plain with those on a U. S. grassland is what some scientists suggest we do. Let's find out why, and whether we can agree with them or not.

Certain western portions of the U. S. are called grasslands because--you guessed it--they are mainly covered with grass. And grasslands are one of four major world-wide biomes that ecologists, environmentalists, zoologists, and many other scientists are now studying. (A biome is a vast living community composed of all the plants and animals of the area. The other three major biomes are tundra (treeless plain), desert, and forest.)

The most common species of grass found on our grasslands is blue grama grass. You can also see other kinds of grass dotting the prairies--blades of buffalo grass and snakewood. But most western U. S. grasslands are misnamed. They should really be renames "scrublands," because of the rapid growth of many bushes and shrubs that are crowding out the grass.

What has triggered this "brush invasion?" For one thing, intensive grazing by cattle and sheep has killed off much of the grass over wide areas. These animals have eaten away much of their natural food source. And where the land has been munched clean, saltbushes, sagebrush, and mesquite bushes have sprung up. Because these desert shrubs contain bad-tasting oils and sport pointed thorns, cattle and sheep won't eat them. This, in turn, has allowed these brushes to spread rapidly.

Droughts have also taken a toll of grass and have left the land open for the brush invasion. Grasses have very shallow roots and, therefore, need frequent watering. But shrubs and bushes sprout deeper roots and are able to obtain water from deep beneath the soil.

Drought and overgrazing have spurred the invasion of the brush--an invasion that worries cattlemen, conservationists, and agricultural scientists. Why all the concern? Many scientists believe that the U. S. is rapidly losing its grazing land. Soon, they say, there will not be enough grass to feed the cattle, which are needed to feed our ever-growing population.

Is there some way to make our grasslands work for us? Dr. Paul S. Martin, of the University of Arizona, has come up with a possible answer to this question--turn the "useless" brush into food. But, you may say, these plants are not food for cattle and sheep. Dr. Martin has an answer for this problem, too. He has suggested that giraffes be imported to graze on our grasslands. Why? Studies of giraffes in their natural African habitats ("homes") have shown that they can eat bushes and shrubs--just what our grasslands have too much of. Therefore, the long-necked browsers would be a natural control for the brush invasion.

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*Science World, September 21, 1970, pages 4, 5.

Dr. Martin has also suggested some additional arguments in favor of importing giraffes. Giraffes, he states, would be a new source of hides and fertilizer. And, most important, they could supply us with meat. (How about giraffe steak, medium rare, for dinner?) Dr. Martin has also considered the problems that might arise if cattle and giraffes lived in the same area and competed for the same territory. Cattle, he points out, drink water frequently. They must live near a source of water. Giraffes do not drink water frequently. They can range far from sources of water. Thus, they would not compete with the cattle for territory near water.

But there are other animals such as birds and insects, vital to the balance of grassland life. Would a giraffe "invasion" upset this balance--and create new and serious problems? Researchers working as part of the International Biological Program, which involves hundreds of scientists from all over the world, have investigated the four main biomes. And they have turned up evidence that may put a roadblock in the path of Dr. Martin's giraffe idea. The roadblock is the lark bunting--the most common bird in the grasslands biome.

The lark bunting is a small bird whose pitch black color is broken by white wing patches. It eats ants and grasshoppers. And it builds its nest on the ground, next to or beneath bushes. The bushes hide the nests from predators. And the most common site for nest building is under the saltbrush.

What would happen if a large browser, such as the giraffe, were to eat the saltbushes? The lark buntings' nests would be clearly visible to predators. The birds' survival rate in the grasslands would decrease. And if the lark buntings disappeared, the main insect predator of the grasslands would vanish. There would be no animal to keep the insect population in check.

Why do scientists fear a larger insect population? Because insects such as the grasshopper, damage the grasslands more than do cattle. How? Grasshoppers eat the part of the blades closest to the ground. Cattle chop off the top half of the plants, which still allows the plants to grow and their seeds to spread. Feeding from the bottom destroys the plants completely and prevents them from reseeding. With the plants gone, the soil is exposed to air and water. The result is eroded (washed away) soil, a more desolate terrain than scrubland.

Now you have some of the arguments, pro and con, concerning the "U.S. giragges." Can you think of any we've left out? After you've thought over this problem, try to come up with your own answer to the question: Should we import giraffes to stop the "brush invasion?"

Questions for "Sticking Out Our Necks, The Case for U. S. Giraffes"

1) What is happening to the U. S. grasslands?

2) What animals have caused the change in types of plants?

3) Why will cows and sheep not eat the brush?

4) How do grass and brush roots differ?

5) Why does Dr. Martin want to bring giraffes into the U. S. grassland?

6) What products could we get from the giraffes?

7) Do cattle and giraffes require the same amount of water?

8) What roadblock has turned up to stop Dr. Martin's project?

9) What good does the lark bunting do?

10) Why do grasshoppers damage grass more than cattle when they eat it?

11) How could bringing giraffes into U. S. grasslands cause soil erosion?

12) Can you make the food web illustrated by this article?

13) Would it help if the number of cattle feeding on the grassland was reduced?

PROTECTED PREDATORS*

By John Speicher

Cruising above ice-jammed Lake Superior near the Canadian border on a bright winter day, American zoologist Dave Mech threw forward the controls of his reconnaissance plane. The craft nosed into a slicing dive through the frigid air. Below, 210-square-miles of snowy, forested island nestled in the icy water. It was Isle Royale, site of a national park, one of the last remaining homes in the U. S. for the vanishing timber wolf (Canis lupus).

All day long, the wolf pack on Isle Royale had pursued moose across a gleaming winter slick of ice and snow. And all the while, zoologist pilot Mech had tracked the pack of timber wolves from the sky--keeping the roving predators under constant surveillance.

His observations had a special urgency. Time may be running out for the timber wolf in North America. Recently, the U. S. Wildlife Service put the creature on its official list of endangered species.

The menacing wolf, in danger itself?

Oddly, yes. True, wolves were once common enough in the U. S. But as settlers cleared the land of forests, they rolled back the wolf's wilderness home like a vast, unwanted carpet. And, fearing the predator as a killer of domestic livestock, state governments put a price on the wolf's head--a bounty. Cut down in droves by bounty hunters at the same time as its wilderness was disappearing, the wolf found itself attacked on two fronts. Today, with a bounty still on its head in most states, the wolf may be threatened with extinction.

WOLF ATTACK!

In Isle Royale National Park, timber wolves are protected from hunters by law. And there's another plus. The island is a place where zoologists can still observe wolves in the wild. And this yields clues to the ways in which animals cope with the hazards of their environment. (The island is also home to herds of moose, upon which the wolves prey for food.)

As Dr. Mech came in over the island, he spotted an old moose cow lumbering through the snow. Strung out in single file at her heels loped a pursuing pack of fifteen wolves.

Dr. Mech circled, and watched. Wolves leapt ferociously at the old cow's flanks. But the hulking animal lumbered on, flicking off her tormentors with powerful heaves of her muscular body.

Then the cow blundered onto the ice of a frozen stream. The ice cracked. Now, she was trapped. One wolf jumped up and seized her nose. The cow swung her head, cracking the wolf in the air like a whip. The wolf lost its grip and sailed away.

The aged moose beat off the other wolves and plodded into a thicket. There she stood her ground, prepared to trample her enemies under her hooves if they dared to resume their attack. But time was against her. Blood stained the snow. And pilot Mech, banking low in the sky, saw that the cow was bleeding badly. "The wolves," he reports, "didn't finish her off until she had weakened greatly."

*From Science World, November 1, 1968, pages 4-7.

Observations such as Dr. Mech's are revamping scientists' beliefs about the wolf. Long considered an efficient killer of moose, deer, elk, and other big game, the wolf--under closer scrutiny--comes off as anything but a spectular success.

For instance, Dr. Mech saw the Isle Royale wolf pack attempt 131 different kills. One hundred and twenty-five times, the moose either outran the pack or fought off the wolves in a "head-to-head" struggle. Only six times did the wolves succeed in scoring a kill.

Over the course of his three years spent studying the pack, Dr. Mech performed autopsies on some 50 wolf-killed moose carcasses. These examinations disclosed that the overwhelming majority of the kills were either very young--under the age of one year--or very old, over the age of ten. Many of the remaining moose were sick--the most common disease being a lung infection caused by parasitic worms. Obviously, any moose with worm-riddled lungs wouldn't stand much of a chance outrunning the pack or outlasting it in prolonged battle.

Such facts led Dr. Mech to a startling--and controversial--conclusion. Though wolves kill some individuals of a herd, they improve a herd's chances for survival. Does this sound contradictory? It isn't.

By removing diseased animals from the herd, wolves play a "sanitation" role. They help nip diseases in the bud, before an epidemic gets started.

Also, by winnowing out the young animals, the wolf pack helps keep the herd relatively small. Zoologists know that, in ranges where herds become too large, animals tend to overgraze the land. Often, they completely wipe out grasses and other food supplies. As a result, mass starvation usually follows.

Dr. Mech and other observers of Isle Royale's wolves were puzzled by one finding. In the several years since the wolves had been protected by law, their population hadn't shown any significant increase--never more than 28 wolves on the whole island, with an average yearly census of 23 over an eight-year period.

How come the protected wolves didn't increase in number?

DOMINANT "MATCHMAKER"

One possible answer comes from American zoologist Jerome Woolpy, who studied wolves in captivity at Brookfield Zoo, Chicago, Illinois. At Brookfield, captive wolves lived in a pack within a contained territory a large pen.

Dr. Woolpy noticed that the wolf pack had a definite hierarchy--social ranking system. It was something like a pecking order among birds. In wolf-pack hierarchy, there are dominant (aggressive) and submissive (less aggressive) animals.

Usually, when approached by a submissive wolf, a dominant wolf perks up its ears, bares its fangs, and snarls. The submissive animal draws back its ears, slinking along the ground with its tail between its legs. If a fight should develop, the submissive wolf almost always exposes its throat to the higher-ranking wolf as a sign of "surrender."

At this point, the dominant wolf could easily rip out the submissive wolf's throat. But no one, including Dr. Woolpy and Dr. Mech, has ever seen this happen. Instead, the high-ranking wolf stops attacking. It lets its beaten rival slink away.

What has this got to do with wolf-pack populations? Plenty. A dominant wolf, whether male or female, almost never accepts a wolf of lower rank as a mate. Moreover, if a dominant, high-ranking wolf sees two lower-ranking members of the pack engaged in courtship, it attacks the pair and prevents their mating.

Thus, high-ranking wolves prevent mating among lower-ranking, more submissive members of the pack. Result: Those animals less able to meet the challenges of their environment simply aren't born.

At the top of the wolf-pack social structure is a strong, dominant male--labelled by scientists, the "Alpha male." Perhaps you think the Alpha male would be most likely to mate and produce young for the pack?

Not so, says Dr. Woolpy. For some mysterious reason, the Alpha male usually appears totally uninterested in mating.

Quite a complicated picture, no? Comments Dr. Woolpy: "The existence of a firmly established social hierarchy in both sexes places severe restrictions on the mating habits of the group. In five consecutive seasons, from 1960 through 1964, only one litter was born in the pack each year. . .The social system controls the mating and population of the pack."

Thus the behavior of wolves in a pack seems to serve as a popualtion-control process. But suppose that numerous members of the pack were shot by hunters or killed off by disease--then what happens? Scientists believe that the wolf hierarchy falls apart. This probably allows more matings to take place, and more wolves to be born. The pack increases in population.

Today, timber wolf populations are shrinking toward extinction throughout North America. Many conservationists think that more wilderness sanctuaries should be established for the wolf--similar to that on Isle Royale. Some even suggest that, in some cases, wolves should be brought into areas where none now live. For example, "imported" wolves might be a good control for Yellowstone National Park's big elk herds.

The population of Yellowstone's elk has "exploded" to the point where 1,000 or so must be trapped and shot by rangers each year. Otherwise, Yellowstone's overpopulous elk would overgraze their range--bringing disaster to themselves and other animals.

But other voices caution against importing the wolf to Yellowstone from its Wilderness retreats. They point out that wolves are great travelers--covering as much as 30 miles a day in search of food. Suppose the wolves strayed away from Yellowstone to prey on domestic livestock--much easier quarry than wild elk?

In 1968, Little Red Riding Hood's old forest foe is himself in danger. Should more "Isle Royales" be staked out as protected arenas for the wolf? Should he be the object of elk-control experiments at Yellowstone?

What do you think?

Questions for "The Wolves of Isle Royale"

1) What interaction exists between the timber wolf and the moose?

2) What activities of man caused the timber wolf to be placed on the endangered species list?

3) What is a bounty?

4) Are wolves efficient killers?

5) What type of moose did the wolves kill?

6) How do wolves killing moose help the moose species?

7) How does social ranking within the wolf pack influence population size?

8) What happens when the wolf hierarchy is disturbed by man?

9) How could wolves be used in Yellowstone?

10) Construct a food web illustrated by this article.

11) What type of environment does the timber wolf need?

12) Is it important or worthwhile to save animals like wolves from extinction?

13) What are some structural adaptations the moose can use to protect himself?

APPENDIX E

Teacher Special Resources

The following material is provided to assist teachers in carrying out the various unit activities.

Sketch Evaporation-Condensation Cycle Demonstration
Sketch of Oxygen Demonstration E-2

Organism Relationship Diagram E-3

Food Web Diagram
(illustrates how the classroom food web might appear). E-4

Living Communities in the Classroom
(simple ways to maintain plant and animal life in the classroom) . . E-5

Uses of the Strand Terms in Various Subjects. E-9

Unit Discussions Topics E-11

Data for Population Graphs
(United States, Kansas, Snowshoe-hare, Ring-neck pheasant) E-16

Sample graph of United States Population. E-17

Sample graph of Kansas Population E-18

Sample graph of Ring-neck Pheasant. E-19

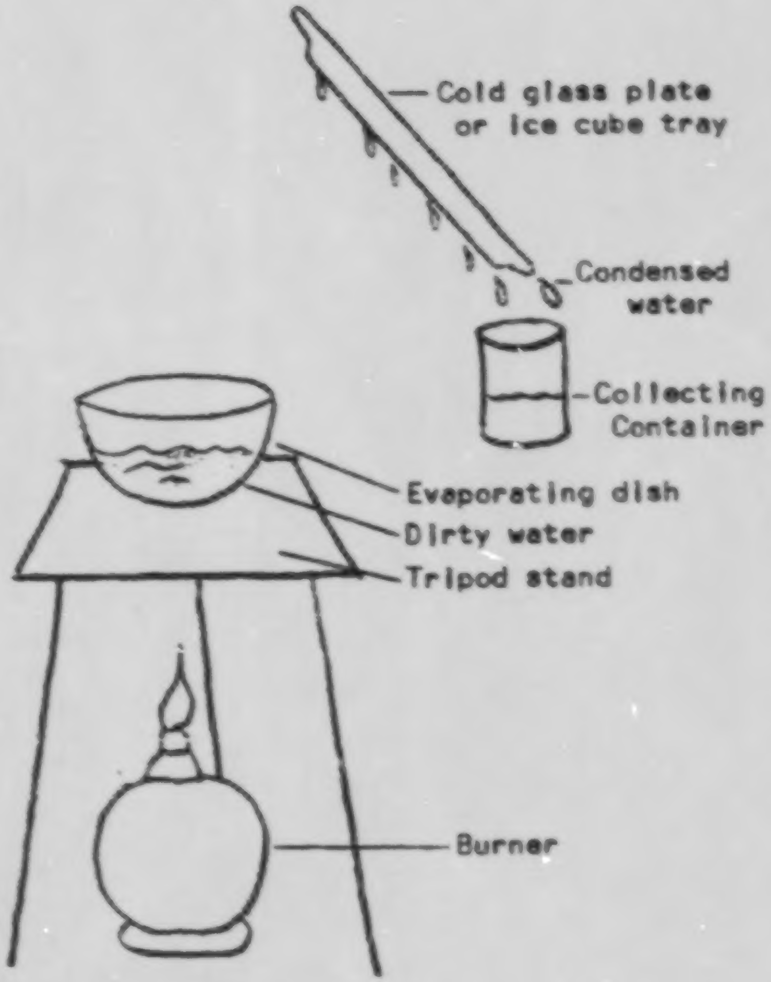
Sample graph of Snowshoe-hare E-20

NASA - Lost on the Moon Exercise
(use to emphasize the basic needs for life). E-21

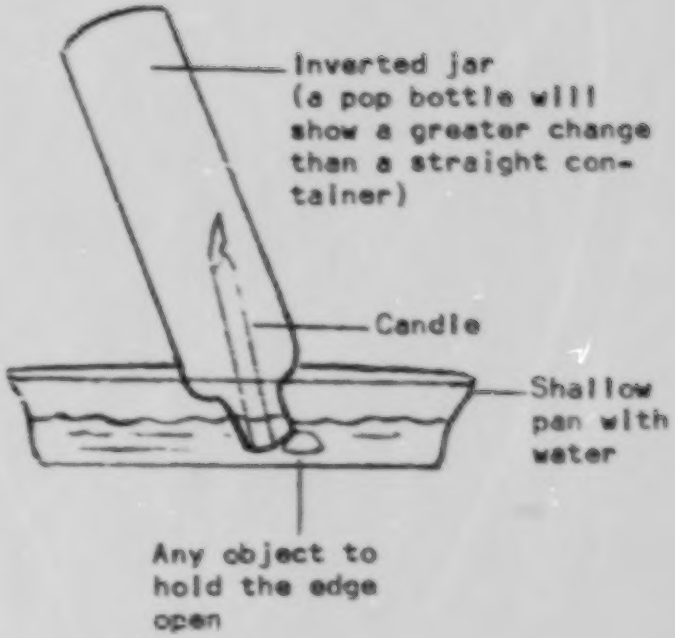
Natural Problems. E-24

Scramblers (Can be used as individual fun activities
or as review guides) E-25

Sketch for demonstrating the evaporation-condensation cycle

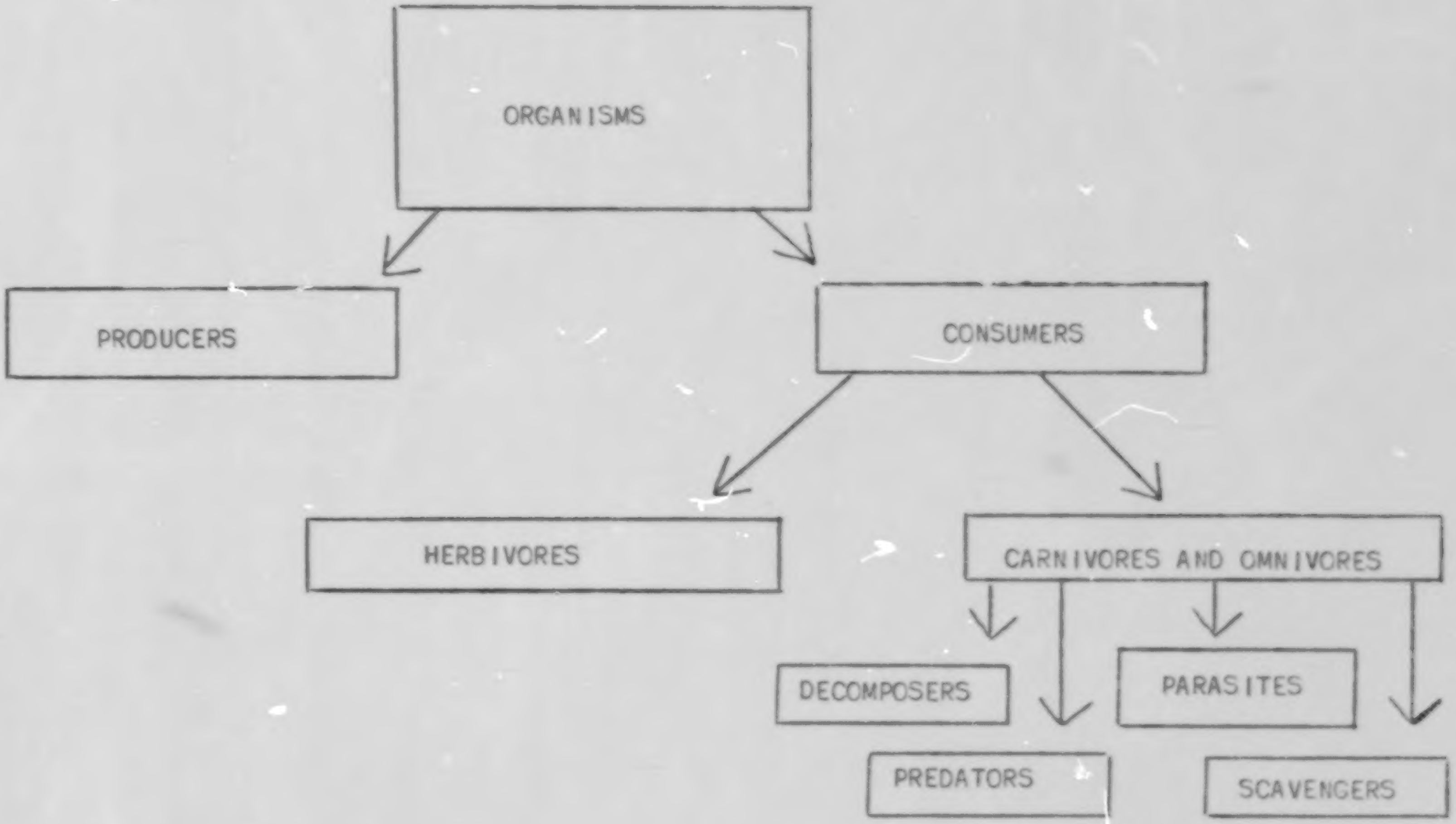

Cold glass plate or ice cube tray
Condensed water
Collecting Container
Evaporating dish
Dirty water
Tripod stand
Burner

Sketch for demonstrating the amount of oxygen in the air


Inverted jar (a pop bottle will show a greater change than a straight container)
Candle
Shallow pan with water
Any object to hold the edge open

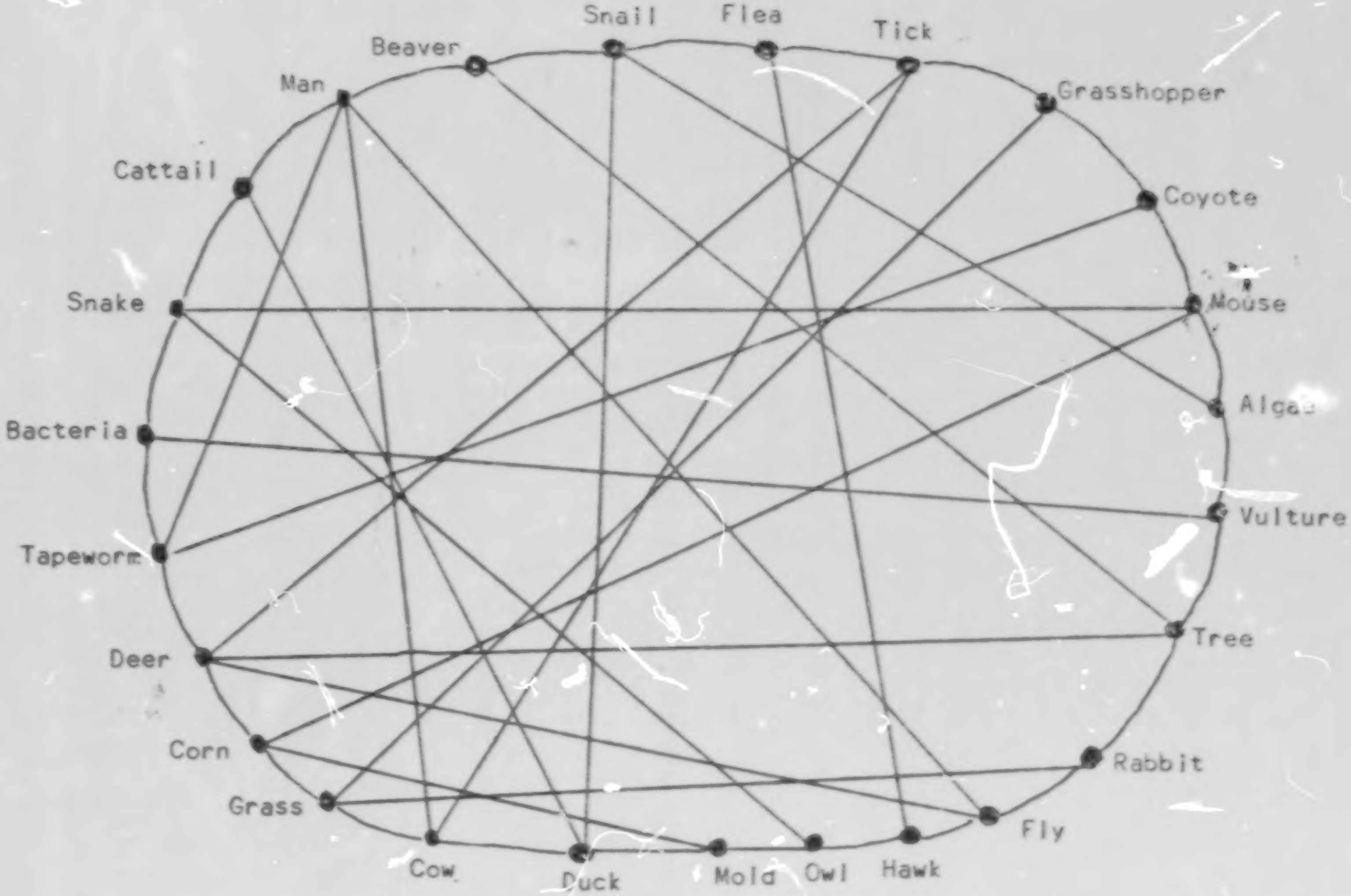
ORGANISM RELATIONSHIP DIAGRAM

(Sets and Subsets)


ORGANISMS
PRODUCERS
CONSUMERS
HERBIVORES
CARNIVORES AND OMNIVORES
DECOMPOSERS
PARASITES
PREDATORS
SCAVENGERS

E-4

FOOD WEB DIAGRAM


Snail
Flea
Tick
Beaver
Man
Grasshopper
Cattail
Coyote
Snake
Mouse
Bacteria
Algae
Vulture
Tapeworm
Tree
Deer
Corn
Rabbit
Grass
Fly
Cow
Duck
Mold
Owl
Hawk

Introduction -

There is no better way to understand life and its many forms, than through daily contact. Several suggestions for ways and forms of life you can maintain in the classroom are provided. All the suggestions given include simple procedures. None of the suggestions are completely trouble free, but will produce workable results most of the time. Various activities can be assigned as student projects with everyone benefiting by observing changes.

Use the live organisms as teaching tools by making daily or weekly observations and recording data. Have students do research on various aspects of each organism's influence and relationship. Have the students suggest ways to design experiments to find answers to their own questions.

Students, not the teacher, should be responsible for caring and maintaining the various organisms. Do not always be cleaning and starting over. Sometimes the unexpected or a failure is the best teaching tool. Do not tell students what is going to happen, it probably will not occur anyway. Students are the best source for organisms like goldfish and animals that can be kept in a classroom.

1. Aquaria--Every three or four students can establish a gallon jar aquarium. Since this bottle is small, it limits the amount of life that can be maintained. The surface area is the most important factor so don't fill a jar completely to the top with water. Use goldfish, minnows, or guppies and about one gallon of water for each inch of fish. One fish is enough for an aquarium. Usually some student has an excess of fish to provide for everyone. Put in a water plant and a snail to start a more nearly balanced aquarium. Be sure not to use chlorinated water without letting it sit for at least a day. Have students research proper care of aquariums. It is important that the students get involved and feel ownership if they are to make careful observations. A large classroom aquarium is a nice addition and excellent habitat for comparison, but not a substitute for the individual ones.

2. Terraria--Every three or four students can construct a simple terrarium by getting a large mouth gallon jar, placing it on the side and filling the lower 1/3 with soil. Small plants and soil can be transferred in the winter. The plants or seeds will start to grow when warmed. Add a few insects and slightly moisten before closing the lid and laying the terrarium on its side in a warm room. Many changes can be observed over a period of time. Don't throw out plants when they look dead. They often will start growing in a few weeks. This death and new growth is an excellent way to lead into discussions about succession. The wide mouth jars can be obtained from food service centers.

3. Bottle garden--Have each student bring any type of bottle, partially filled with soil. Plant seeds in it. Moisten and start daily observations.

4. Algae garden--A collection of algae can be easily started by setting up a gallon bottle for an aquarium (described above), but leave out all items but the water plant. Use a bottle of aquarium plant fertilizer (purchased at any pet shop), and fertilize at about three times the recommended rate. Place a light (40 watt flourescent is best) over the garden if possible, and leave it on 24 hours a day. Make sure that the water temperature is not changed more than a few degrees.

5. Micro-organisms--Microscopic organisms never fail to catch a student's eye. Any natural water supply will contain several kinds. To produce a rich culture place dry grass and some soil in a jar partly filled with non-chlorinated water. After 24 hours you should find many microscopic beasts either on the surface, on the bottom, or on the grass blades. This will be even richer if you can add dry alfalfa and some manure to the culture. Keep the culture and view it over several days. Try cultures using different plant and water types.

6. Mold--Many natural molds can be cultured and observed by leaving various food samples exposed to the air. The samples will need to be kept moist. Bacteria will also be growing on the food and unless large colonies are formed, the bacteria cannot be seen without magnification. Odors from decomposing can be observed. Spore cases or reproductive structures will be observed on the mold and many colors can be seen. Use a hand lens and observe the mold fibers growing into the food. Some mold groups can be identified observing the spore case shape and patterns and using reference material.

7. Meal worms--Not only can meal worms be used as a food for several reptiles, but they can be used for experiments themselves. What temperature do they prefer? Do they prefer light or dark areas? Do they prefer smooth or rough surfaces? Students can design many other interesting experiments.

   Meal worms can be raised in almost any type of container to a depth of several inches with wheat bran or a similar wheat product. This may be mixed with a chicken mash and hog meal. Place a moistened piece of burlap over the meal and then place another inch of the meal over the burlap. Obtain several meal worms from a pet store or a grain elevator. Cover the container with screen to prevent escape of adults that develop. Add a slice of raw potato weekly. Adults normally develop in early spring and lay eggs from May to late October. Larvae will develop during the winter.

8. Termites and Ants--Termites and ants are always interesting to watch and relatively easy to maintain. A container can consist of a quart jar placed inside a gallon jar with the space between them. If a thick soil area is available, you will not see the ant trails. The outside should be covered except when viewing. Ants burrow away from light. The soil should be slightly moist and firmly packed in the container. When collecting the ants or termites, gather some of the soil they are in and place it in the container. Weekly feeding of sugar and a few drops of water will be sufficient for termites while ants need some protein like eggwhite. An ant food of one part eggwhite, one part vegetable oil, one part syrup, and two parts water can be made up and stored in the refrigerator. Place a few drops of the mixture in the container weekly.

   Cut open a termite and place its stomach on a microscope slide and view the protozoan inside that digests the wood. The protozoan will remain alive if you place a drop of salt water on the slide.

9. Crickets--Any container will work for culturing crickets. If it is eight or more inches high, no cover will be needed. Place about an inch of moist sand in the bottom of the container. For adults, include a very shallow dish of water. Crickets can live on rolled oats, but a better food is a paste consisting of rolled oats, sugar, skim milk powder, and water. Dry the mixture and cut into about inch squares. Feed one every few days as needed. Any green plant material can also be used as food, but remove it if it molds. A chameleon can be added to the cricket culture and observe the predator-prey relationship.

10. Cockroaches--Cockroaches are excellent for illustrating incomplete metamorphosis, and an interesting critter to watch. Almost any container with a screen cover that can be darkened or kept in a dark place will do fine for their home. Place several layers of glass in the container and separate them 1/4 inch. The roaches will live in the layers. Water is best supplied from a bottle inverted in a shallow dish. Place a microscope slide under the edge of the bottle to allow water to enter the dish. Place cotton around in the dish to prevent drowning. Food can be dog biscuits supplemented by potato, apple, and lettuce on a weekly basis. The container will rarely need cleaning. Sawdust can be added to the container if desired.

11. Fruit Flies--Fruit Flies can be collected by leaving some overripe fruit, like bananas, in an open jar outside anytime except mid-winter. The flies require a fermenting material, moisture and solid area for an egg laying surface. Many elaborate formulas exist, but a simple and inexpensive environment for use in the classroom is a ripe banana, yeast, paper towel and some water in a jar. Cover the top so air can enter. Add moisture when needed. If you have problems with mold it is easier to start over than to control the mold. The mold can prove to be interesting to observe.

    The fruit flies can complete a life cycle every seven days, thus are excellent for observing population growth. The eggs are very small and require extreme care if they are to be observed. The larva, pupa and adult stages are easily viewed and are interesting to view. Males and females can be identified. When raised in a jar in which no food is added, you can observe the effects of a limited food supply; the accumulation of waste, and the growth and decrease of a population within a few weeks.

12. Houseflies--Although most people are familiar with the adult housefly, few people have viewed the complete life cycle. Being larger than the fruit fly, it is easier to observe. It is sometimes harder to maintain in a confined area than the fruit fly. The stages of a housefly vary slightly from those of a fruit fly.

    To establish a housefly culture, start with a one gallon jar, cover the bottom about one inch deep with horse manure or a mixture of rolled oats, bran and alfalfa pellets. Add a pinch of mold inhibitor, such as sodium propionate. Place dry powdered milk or granulated sugar in a small jar lid for food and place on the horse manure. Place a small bottle containing water beside the food pan. Fix a wick using cotton or paper towel to draw the water from the bottle. The lid on the gallon jar should have screen or other material that will allow free passage of air. Stock your jar with a few adults and you are in business.

    Laboratory colonies are frequently lost because the medium is not kept moist. The amount of moisture needed for developing flies will vary during the different stages of development, with the larva thriving in a wet to very moist environment and the pupa developing best under drier conditions. The amount of moisture available will affect the rate of development. If the medium is kept wet at the bottom, the larva will utilize the area of optimum moisture and will migrate to the drier portion for pupation.

    The sexually mature housefly (10-14 days old) will lay about 120-150 eggs within 4-8 days after copulation, and the larva will hatch in 8-12 hours. The larva will go through three instar stages (24 hours - 24 hours - 3 days) and into the pupa stage for 3 days. Temperature will affect the length of each stage.

13. Gerbils--Gerbils are a relative trouble free mammal to raise in the classroom. The odor that is common with most mammals like rats and mice is almost missing. Any cage with about a cubic foot space will house a pair of gerbils. Gerbils are an arid land animal and can survive on very little water. If you do not wish to use a water bottle, just place an apple or potato in the cage and they will have sufficient water. Food can consist of any grain and leafy green plants. Sometimes it is helpful to add a few drops of vitamins to the food or water supply. Gerbils fed vitamins will not tend to eat their young. The cage will only need infrequent cleanings if you use sawdust in the bottom.

The gerbils should be provided with something they can hide within, a used towel roll will do fine. The male will help care for the young if left with the female. Often, the young will be scattered throughout the cage when born, don't become concerned.

14. Earthworms--The common earthworm feeds mostly on decaying leaves. The worms may be kept in a box that is about twelve inches deep. Fill the box with a mixture of leaf loam and old leaves. The best samples can usually be found in wooded areas with a good ground cover. Keep the material moist but not wet. No additional food will be needed. When stocking your box, do not add any injured worms. Keep the box at a temperature of about 60°F. and cover with a glass plate. Put no more than 50 worms per cubic foot of soil. Once established, do not disturb for a few weeks other than to check for moisture. In two or three months, examine the soil for changes in texture. Have the worms multiplied or layed eggs? The eggs will be yellow, football shaped, tough skinned, and about 1/8 inch long. Have the worms grown? The earthworm is a very important decomposer and a soil mixer and aerator.

USE OF THE STRAND TERMS IN VARIOUS SUBJECT AREAS*

The strand concepts as developed by the National Park Service not only are useful while studying the environment, but also can be readily used in other educational areas. If students think in terms of the strand concepts, they will develop a learning pattern and observational skills which they can use in any subject. The following questions and suggestions are offered as guidelines for introducing the strands into various subjects.

Social Science -

1) When studying various countries view them in terms of how are they similar to the United States? How are they different?
2) What pattern or organization do they use for moving farm products? What pattern exists in the social structure?
3) How does the country interact with other countries? Do they exchange trade? Using the same mechanics as used in the food web, the yarn and role playing, one can illustrate relationships between countries. Let each student be a country and each string could represent some exchange such as wheat between them.
4) How has the life style of the people changed?
5) How have the people adapted or adjusted to living in their physical environment and their social environment?

Math -

1) In what ways are number systems the same? In what ways are they different?
2) What patterns can be found in number series? Develop number series with patterns and see if students can find the patterns and continue the series.
3) Can they develop number combinations that are equivalent? The use of Krypto cards will illustrate the interaction of numbers.
4) Use graphs to illustrate changing values.
5) What are some examples of how people have adapted number systems to fit their social system? What about the metric system?

Language Arts -

1) How are the expression of boys all alike when they see a new animal? How are their expressions different from the girls?
2) What pattern can the students find in their own speech habits? What patterns are found in the library?
3) How does changing the verb in a sentence change the action of the subject?
4) What are some ways to change the intent of an expression?
5) What are some words that Americans have adapted or modified for their use?

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*See Activity 3.1 for an explanation of the strand terms.

Art -

1) When comparing art painting of two different periods or of different men, look for their similarities and variations.
2) What gives the work of art its pattern?
3) Can a picture illustrate change or can change only be illustrated by a series of pictures?
4) Does everyone interact the same with a work of art?
5) What are some examples of how artists have adopted modern materials and methods for use in artistic expressions?

These questions, provided for the classroom teacher's use, are designed for initiating class discussion and are open ended. These questions will create interaction between students and will act as an additional teaching tool. During the student discussion, the concepts within the question can be developed. Many of the questions can be used as an informal pre-post evaluation instrument.

Basic Needs For Life - Topic I

1. Can animals live on the earth without green plants?

2. Where does the energy man uses come from?

3. List three things all green plants need if they are to grow.

4. What does man get from food?

5. Why is the sun important to man?

6. List three things all animals need.

7. Where does food production occur?

8. Name some important food producers.

9. What is combined to make food?

10. What is a waste material given off by green plants that is used by animals?

11. List two ways our body uses water.

12. How does our body use oxygen it gets from the air?

13. What waste material do we breathe out into the air? What organisms use this waste material?

14. Why do animals sweat?

15. What are some of the activities performed by blood within animals bodies?

16. During the burning of foods inside animals bodies, what is released?

17. If you were alone, without equipment, in a desert for three weeks, what would be your greatest need in order to survive?
   A) food B) water C) air D) shade

18. Which of the following things supply the energy plants need to grow? Circle only one.
   A) oxygen B) food C) water D) light

19. Circle the four things which all green plants must have to grow.
   A) water B) oxygen C) carbon dioxide D) minerals E) drainage
   F) sunlight G) fertilizer

20. Circle the two best reasons for eating food.
A) to get energy B) to stop hunger pains C) to get materials for body growth D) to give strength E) to keep nature in balance

21. Circle the three things in the following list that are basic biological needs for you.
A) taking a bath B) eating a balanced diet C) smoking D) eating meat twice a day E) drinking water F) exercising G) breathing H) looking and listening for dangers

Food Web - Topic II

1. Give some examples of how plants depend on animals.
2. Give some examples of how animals depend on plants.
3. Is there such a thing as a single food chain existing by itself in the natural world?
4. Give some examples of how the non-living conditions influence where plants and animals are found.
5. Where do producers get their food?
6. How is a herbivore different from a carnivore?
7. Why do highly populated countries eat more plant food than meat foods?
8. What is the role of a decomposer?
9. All food chains start with a __________.
10. What happens to the material in an animals body when it dies?
11. Give some example of predator-prey relationships.
12. Give some example of parasite-host relationships.
13. How is a scavenger different than a predator?
14. What would happen to the rabbit population if there was no predators?
15. Give some examples of adaptations predators have that aid them in capturing food.
16. Do parasites kill their host?
17. Compare the effect parasites, predators, and scavengers have on the population of their food sources.
18. How will our food habits change if the people population continues to increase?
19. Give some illustrations of competition between animals.
20. Draw a food chain with four organisms in it.

21. Draw a food web with six organisms in it.

22. George Allen had always had one of the most beautiful rose bushes in the neighborhood. The roses were beside his house, and were always the prettiest just before the annual Rose Growing Society's Fair. However, for two years in a row, heavy rains the week before the Fair had ruined the flowers by knocking off petals. This year George had vowed to win the Fair with his roses, so he built the roof of his house way out over the rose bush, and watered the bush with his garden hose.

    All his efforts failed--his bush looked very bad and produced only a few tiny roses. Many of its leaves died and it looked as if the whole plant would go soon.

    What was wrong?

    A) The lack of sunlight energy is killing the plant.
    B) Rose aphids are killing the plant leaves.
    C) Something in the water from the garden hose is killing the plants.
    D) Rose leaves need to be washed by rain in order to keep breathing

23. Circle the line which best completes the sentence below. When a man plans to build a highway, a lake, or a housing development:

    A) he should carefully study the animals and plants in the area, for all of these changes will change their populations.
    B) he should carefully study the animals and plants in the area, for some of these changes will change their populations.
    C) he should carefully study the animals in the area, for some of these changes will change their population.
    D) he should carefully study the animals in the area, for all of these changes will change their population.

24. Why would an ecologist say that Chinese people eat mostly plants, while Americans eat quite a bit of meat?

    A) Because Chinese people are mostly first order consumers.
    B) Because Chinese people are poorer, they don't raise cows and they can't afford to buy meat.
    C) Because much energy is wasted by being a second order consumer and Chinese people cannot afford the waste.
    D) Because Chinese people eat fish and they don't want to eat other meat.

25. Why does a sanitary landfill, which buries garbage, slow down the carbon dioxide - oxygen cycle? Choose the best answer.

    A) Because decomposers cannot obtain enough oxygen to live and decay the garbage.
    B) Because scavengers cannot eat the garbage and release oxygen.
    C) Because plants cannot grow on the garbage and release minerals.
    D) Because plants cannot grow on the garbage and use its carbon dioxide.

26. Place the letter in front of the best sentence in the space below.

    A) In a natural world, some animals and plants change the lives of some other animals and plants.
    B) In a natural world, some animals and plants change the lives of all other animals and plants.
    C) In a natural world, all animals and plants change the lives of all other animals and plants.
    D) In a natural world, all animals and plants change the lives of some other animals and plants.

27. Box turtles eat insects, wild strawberries, fruit, worms, and almost any soft food found within their reach.

    The zoo is planning a natural exhibit for the turtles, where they would be given only water and allowed to eat any natural food growing in their large enclosure.

    Which of the following changes will hurt the turtle population the most?

    A) Placing their water in a small pond.
    B) Putting chicken wire with large holes around the enclosure.
    C) Putting a roof over the exhibit to keep it cool.
    D) Applying artificial heat in the winter.

Select the term that best matches the definition.

28. An organism from which a parasite receives its food.
29. When two or more organisms need the same food or space.
30. An organism which gets food from another living organism.
31. Animals that serve as a clean-up crew by eating dead organisms.
32. The changes an organism goes through in its lifetime.

A) Scavenger
B) Parasite
C) Host
D) Competition
E) Life Cycle

Select the term that best matches the definition.

33. Organisms that return dead matter to soil.
34. Green plants that use sunlight to manufacture food.
35. The set of all organisms that must eat to live.
36. Organisms which are captured and eaten by larger organisms.
37. Organisms which catch and eat animals.

A) Producer
B) Predator
C) Consumer
D) Decomposer
E) Prey

Observational Skills - Topic III

1. In one minute, list as many different things as you can remember observing between your home and school.

   Teacher note: Did they list any plants, any animals, did their list reflect use of any senses other than sight? Give this question a few days later to see if they are now observing any more.

2. List as many adjectives as you can in one minute.

   Teacher note: Examine their lists for how many senses are being reflected. Examine for some pattern within their choices. Repeat this question after doing some of the exercises using the senses and examine the list for changes.

3. Give ways you would decide what season it was if you were standing in the middle of a forest.

4. List several things that can be found in the soil.

5. If you were going to describe a tree so that someone else could pick it out of a group of trees, list five different things you would need to describe.

6. Give examples that will illustrate each of the strand terms: similarity, variations, adaptations, patterns, change, and interaction.

7. Give a student an object and ask them to describe it.

   Teacher note: Keep a record of the number of senses used and the variation of adjectives the student uses.

8. If you were given a small animal, for example a grasshopper, what parts of it would you use in describing it?

Environmental Changes and Man's Influence - Topic IV

1. Does change occur naturally without man's influence?

2. What does the word succession mean?

3. What are some examples of natural changes that man was not involved with?

4. List several ways in which man has modified or changed the local environment.

5. What are some examples where man's changes caused death or harm to other animals?

6. Can man correct all of the mistakes he has caused?

7. What are some ways we can improve the way man uses the environment?

8. What type of planning does man need to do before changing an area, such as building a new lake?

DATA FOR POPULATION GRAPHS*

Graphing Data (Introduced in 1937) Ring-neck Pheasants on Protection Island

Date		Population
1937	Spring	8
	Fall	40
1938	Spring	30
	Fall	100
1939	Spring	90
	Fall	425
1940	Spring	300
	Fall	825
1941	Spring	600
	Fall	1520
1942	Spring	1325
	Fall	1900

U. S. Population**

Date	Population
1630	4
1650	50
1670	111
1690	210
1710	331
1730	629
1750	1,170
1770	2,148
1790	3,929
1810	7,224
1830	12,901
1850	23,261
1870	39,905
1890	63,056
1910	92,407
1930	123,188
1950	151,683
1970	209,000

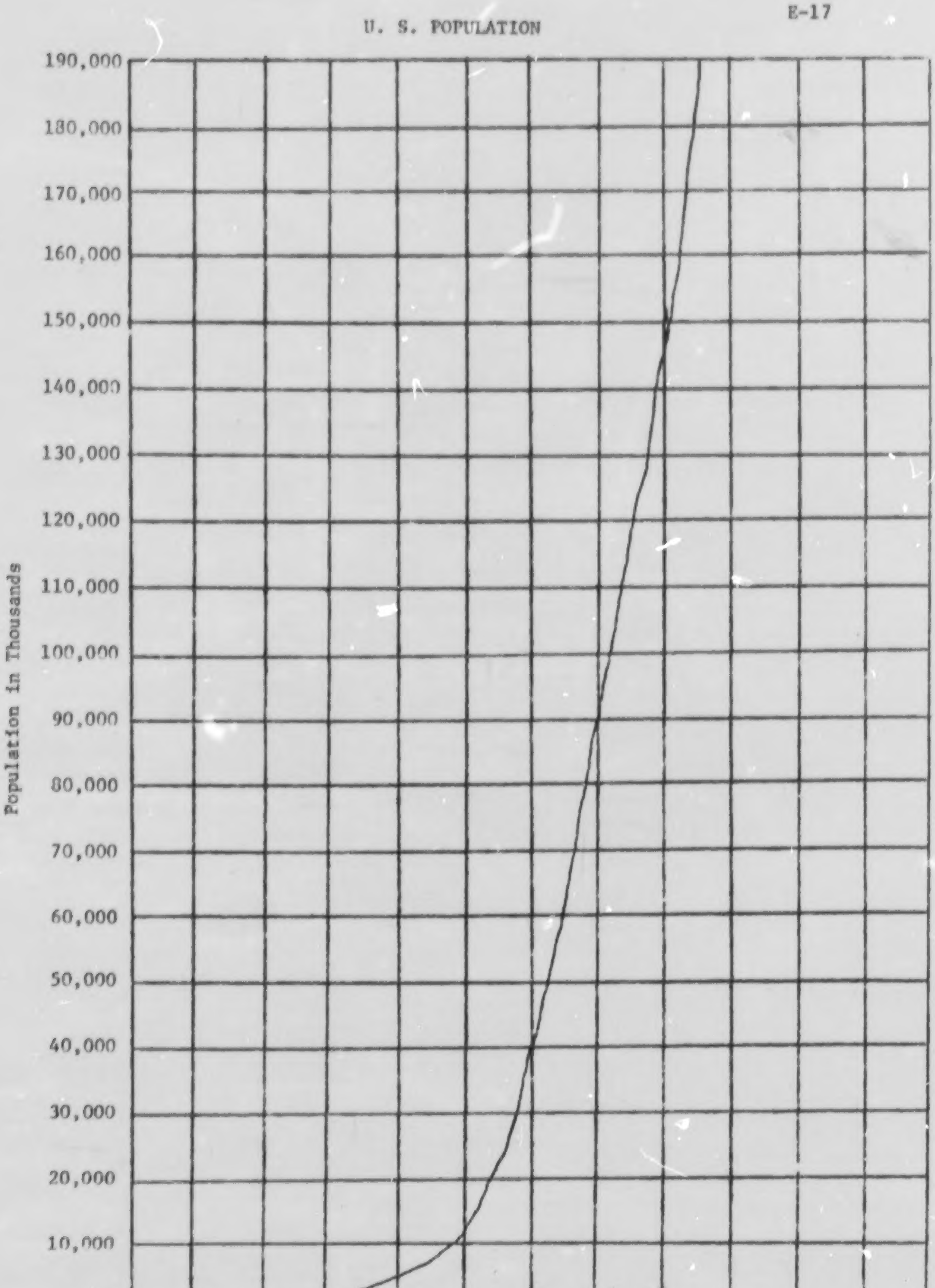
Snowshoe-hare in Canada

Date	Population**
1845	20
1850	40
1855	70
1860	20
1865	140
1870	10
1875	90
1880	10
1885	130
1890	20
1895	90
1900	10
1905	50
1910	60
1915	30
1920	10
1925	60
1930	5
1935	80

Kansas Population**

Date	Population	
1860	107	
1870	364	
1880	996	
1890	1,428	
1900	1,470	
1910	1,691	
1920	1,769	
1930	1,881	
1940	1,801	
1950	1,905	
1960	2,179	
1970	2,300	(Est.)

*See activities 3.21 through 3.24 for an explanation of each graph.
**Thousands


U. S. POPULATION
Population in Thousands
190,000
180,000
170,000
160,000
150,000
140,000
130,000
120,000
110,000
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
1630
1650
1670
1690
1710
1730
1750
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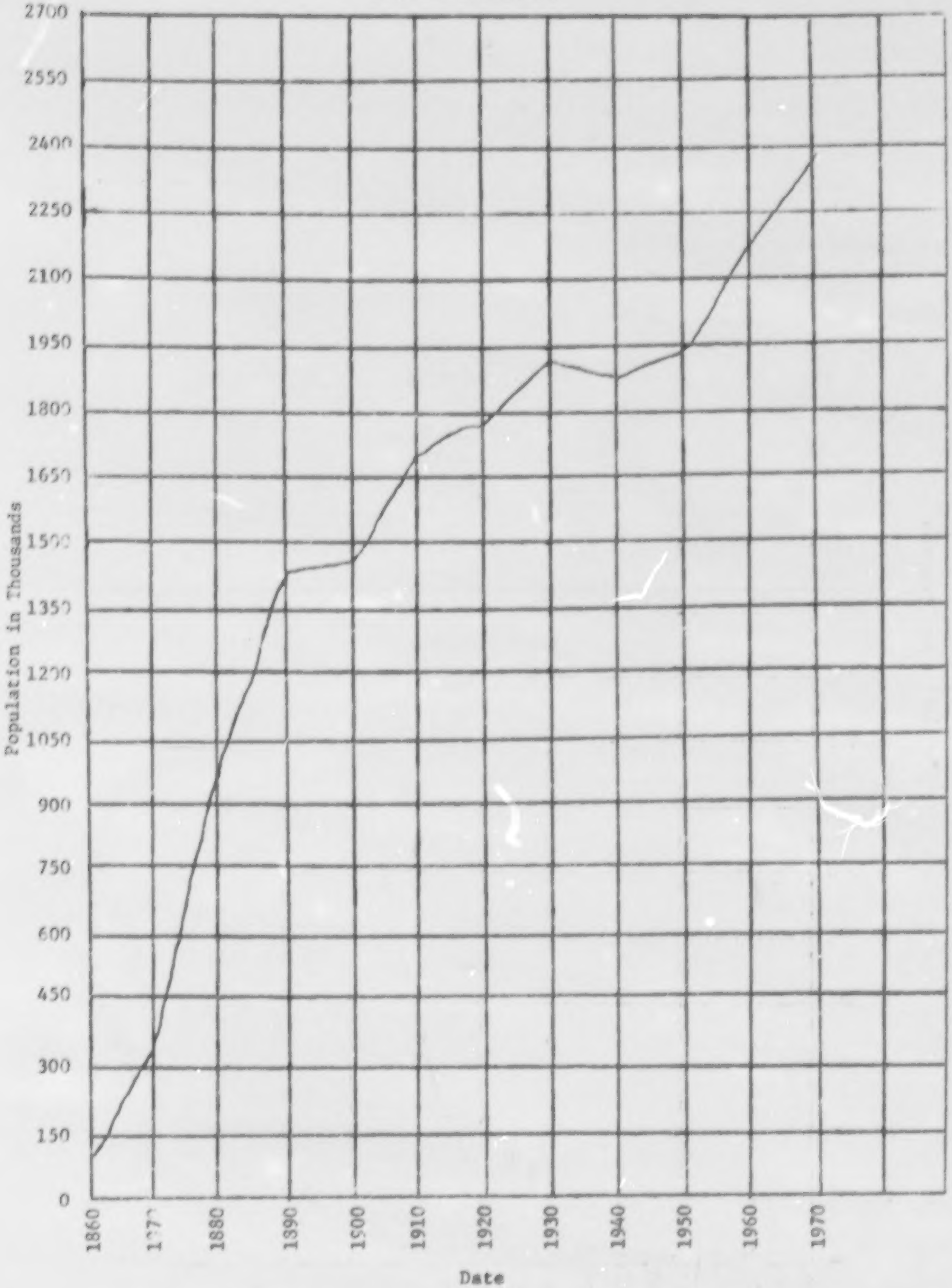
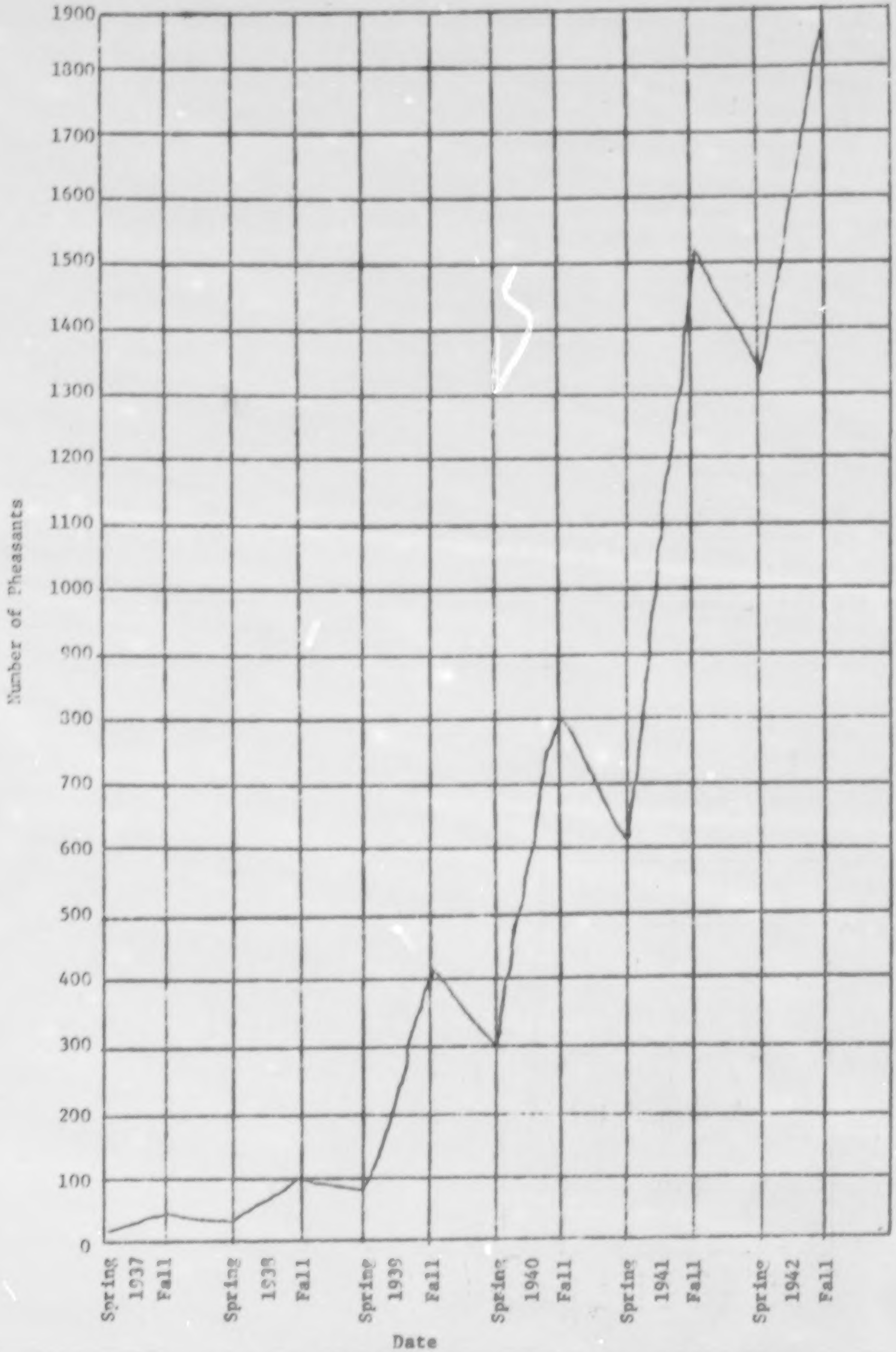
1810
1830
1850
1870
1890
1910
1930
1950
1970
Date

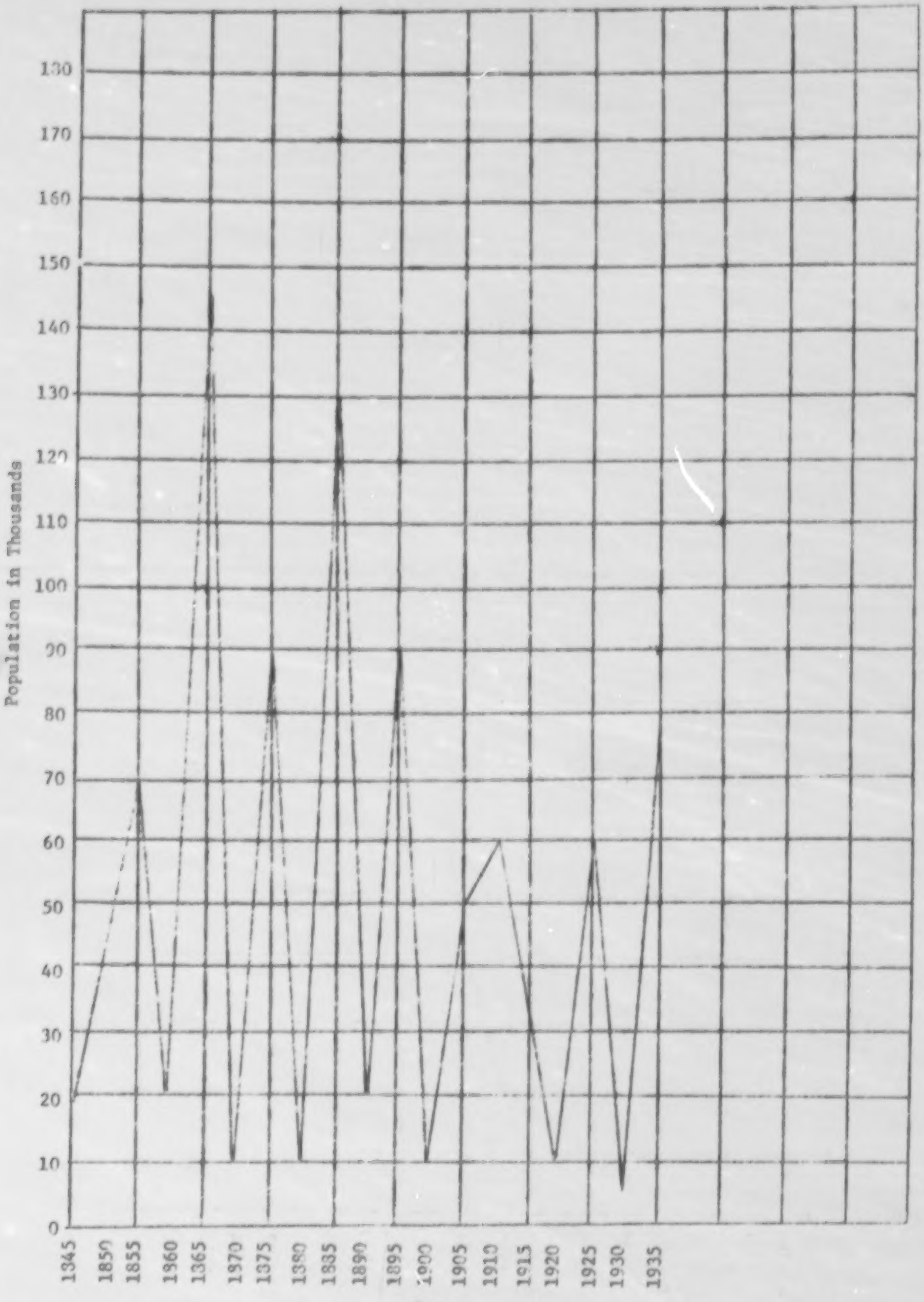
KANSAS POPUALTION



RING-NECK PHEASANTS ON PROTECTION ISLAND (INTRODUCED IN 1937)



SNOWSHOE-HARE IN CANADA



LOST ON THE MOON EXERCISE

The NASA Lost On The Moon Exercise can be used to help students realize which basic needs of life are most important during a short period of time. If it is used as a group activity then the "Decision by Consensus" approach can be introduced.*

Decision by Consensus

This is an exercise in group decision-making. Your group is to employ the method of Group Consensus in reaching its decision. This means that the prediction for each of the fifteen survival items must be agreed upon by each group member before it becomes a part of the group decision. Consensus is difficult to reach. Therefore, not every ranking will meet with everyone's complete approval. Try, as a group, to make each ranking one with which all group members can at least partially agree. Here are some guides to use in reaching consensus.

1. Avoid arguing for your own individual judgments. Approach the task on the basis of logic.
2. Avoid changing your mind only in order to reach agreement and avoid conflict. Support only solutions with which you are able to agree somewhat, at least.
3. Avoid "conflict-reaching" techniques such as majority vote, averaging or trading in reaching decision.
4. View differences of opinion as helpful rather then as a hindrance in decision-making.

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*See instructions and answers on E-22 and E-23.

LOST ON THE MOON EXERCISE

Decision Form

By Jay Hall

INSTRUCTIONS: You are in a space crew originally scheduled to rendezvous with a mother ship on the lighted surface of the moon. Due to mechanical difficulties, however, your ship was forced to land at a spot some 200 miles from the rendezvous point. During re-entry and landing, much of the equipment aboard was damaged and, since survival depends on reaching the mother ship, the most critical items available must be chosen for the after landing. Your task is to rank order them in terms of their importance in allowing your crew to reach the rendezvous point. Place the number 1 by the most important item, the number 2 by the second most important and so on through number 15, the least important.

______Box of matches

______Food Concentrate

______50 feet of nylon rope

______Parachute silk

______Portable heating unit

______Two .45 Calibre pistols

______One case of dehydrated Pet Milk

______Two 100 lb. tanks of oxygen

______Stellar map (of the moon's constellation)

______Life raft

______Magnetic Compass

______5 gallons of water

______Signal flares

______First aid kit containing injection needles

______Solar-powered FM receiver-transmitter

NASA EXERCISE ANSWER SHEET

Rationale:	Correct Answer:	
No oxygen	15	Box of matches
Can live quite awhile without food	4	Food concentrate
For travel over rough terrain	6	50 feet of nylon rope
Carrying	8	Parachute silk
Lighted side of moon is hot	13	Portable heating unit
Some use for propulsion	11	Two .45 Calibre pistols
Needs H_2O to work	12	One case dehydrated Pet milk
No air on moon	1	Two 100 lb. tanks of oxygen
Needed for navigation	3	Stellar map (of moon's constellation)
Some value for shelter or carrying	9	Life raft
Moon's magnetic field is different from earth's	14	Magnetic compass
You can't live long with this	2	5 gallons of water
No oxygen	10	Signal flares
First aid kit might be needed but needles are useless	7	First aid kit containing injection needles
Communication	5	Solar-powered FM receiver-transmitter

NASA Exercise Direction Sheet For Scoring

The group recorder will assume the responsibility for directing the scoring. Individuals will:

1. Score the net differences between their answers and the correct answers. For example, if the answer was 9, and the correct answer was 12, the net difference is 3. Three becomes the score for that particular item.
2. Total these scores for an individual score.
3. Next total all individual scores and divide by the number of participants to arrive at an average individual score.
4. Score the net difference between group worksheet answers and the correct answers.
5. Total these scores for a group score.
6. Compare the average individual score with the group score.

Ratings:

0-20	Excellent
20-30	Good
30-40	Average
40-50	Fair
Over 50	Poor

NATURAL PROBLEMS*

Natural problems are those brought on by the elements, or by living factors within nature herself.

It is not uncommon for people to forget that without man being present, wildlife will still die. The following examples will help illustrate the natural struggles that exist in the absence of man.

Without interference by man, most wild things still have the vast forces of nature working to whittle down their numbers.

An occasional freak storm will wipe out a flock of birds to remind us that struggle and death happen all the time in nature apart from man.

So we have starvation, fire, flood, drought, storms, volcanoes, tidal waves, earthquakes, sleet, hail, snow, wind, tornadoes, hurricanes, heat, disease, and predation.

The deer faces external predation from the wolf and internal parasitism by the liver fluke. Rabbits face quick death to the coyote, slow weakening to the body louse, and slow death to an organism that causes rabbit fever.

Ducks die by the tens of thousands to a disease commonly called "limber neck" or botulism--a sickness that is not caused by the doings of man.

Any person who has dissected the stomach of a bass or pike after catching it is well aware of the relentless pursuit of food by all predators.

In fitting himself into natures scheme of things, man has to make many allowances, for the natural food chains to go on as they have in nature for eons of time.

One is tempted to get emotional about the cruelty of a screech owl taking a young robin, a snake taking a gopher, or a wolf pack killing a tired old moose. But it's all nature's way. Wolves don't have captive bolt pistols or death chambers of CO_2 that can be used in the civilized slaughterhouse of modern man.

Death is a necessity so there can be new life.

Living things must struggle with one another for survival because too many of every living thing is produced.

*Patterns For Preservation, David Tillotson, Great Northern Publishing Corporation, Milwaukee, Wisconsin, 1969, pp. 349-350.

DESERT

C	F	A	L	C	O	N	R	O	Q	A	N	T	O
E	S	T	I	C	K	E	S	F	A	U	Y	C	R
N	H	J	Z	J	E	B	U	U	D	Z	A	R	I
T	R	O	A	D	R	U	N	N	E	R	E	H	O
I	E	X	R	C	O	C	N	G	D	H	Y	C	L
P	W	B	D	D	K	V	Y	I	C	H	F	K	E
E	V	U	L	T	U	R	E	T	A	O	E	E	B
D	P	O	L	A	R	V	A	E	S	T	L	T	A
E	M	I	N	S	E	C	T	B	O	I	P	R	C
O	S	R	A	T	Y	U	M	Y	B	A	T	S	T
C	A	M	E	L	S	C	O	R	P	I	O	N	E
O	N	N	F	O	X	C	E	H	E	A	T	A	R
L	D	D	R	O	U	C	H	T	O	A	D	K	I
D	C	A	C	T	U	S	T	U	R	T	L	E	A

ant
bacteria
bat
cactus
camel
centipede
cold
coyote
cricket
deer
dove
drought
dry

falcon
flycatcher
fox
fungi
gerbil
heat
hot
insect
jackrabbit
larvae
lizard
mold
oriole

quail
rabbit
rat
roadrunner
sand
scorpion
shrew
snake
sunny
toad
turtle
vulture

GRASSLAND

H	S	B	L	C	O	Y	O	T	E	F	O	X	B
A	N	I	M	A	L	R	N	S	K	U	N	K	A
M	O	R	P	G	E	A	G	L	E	P	X	F	C
S	O	D	R	R	S	B	U	S	H	R	U	B	T
T	N	L	R	A	T	B	C	D	W	O	L	F	E
E	G	A	E	S	T	I	B	R	E	N	C	U	R
R	O	H	K	S	F	T	E	A	E	G	A	N	I
G	P	Z	P	E	C	P	L	V	D	H	R	G	A
R	H	A	R	E	O	I	N	E	R	O	D	I	C
O	E	S	S	L	A	D	C	N	S	R	I	F	A
U	R	N	E	U	E	B	I	S	O	N	N	G	T
S	I	T	Q	E	R	A	B	B	I	T	A	N	T
E	N	A	S	B	U	F	F	A	L	O	L	K	L
A	E	A	R	T	H	W	O	R	M	O	U	S	E

animal
ant
antelope
bacteria
bird
bison
buffalo
bush
cardinal
cattle

coyote
eagle
earthworm
fox
fungi
gopher
grass
grouse
hamster
hare

leaf
mole
mouse
pheasant
pronghorn
quail
rabbit
rat
rattlesnake
raven

seed
shrub
skunk
snake
soil
weed
wolf
worm

POND COMMUNITY (I)

M	O	S	Q	U	I	T	O	X	A	D	U	C	K
F	I	S	H	F	Q	B	Z	H	E	R	O	N	S
X	B	C	S	T	S	C	A	T	T	A	I	L	W
P	L	A	R	V	A	E	R	S	M	G	M	N	A
R	A	C	C	O	O	N	D	A	S	O	O	Y	N
O	M	I	N	N	O	W	D	G	Y	N	L	M	B
T	U	R	T	L	E	R	F		E	F	D	P	U
O	S	B	U	G	G	U	G	R	Y	L	I	H	L
Z	K	E	C	T	C	T	E	A	O	Y	C	S	L
O	R	A	J	L	H	T	M	F	N	G	D	Y	H
A	A	V	S	N	A	I	L	O	K	I	L	P	E
K	T	E	L	W	M	M	N	W	S	I	S	Q	A
S	P	R	I	N	G	T	A	I	L	S	R	M	D
S	U	N	F	I	S	H	T	A	D	P	O	L	E

bass
beaver
bug
bullhead
cattail
clam
crayfish
dam
dragonfly

duck
egg
fish
frog
hawk
heron
larvae
lily
mayfly

micro organism
minnow
mold
mosquito
moss
muskrat
nymph
protozoa
raccoon

sedge
snail
springtail
sunfish
swan
tadpole
turtle
water

POND COMMUNITY (2)

C	L	A	M	I	N	K	S	P	I	D	E	R	D
P	C	K	I	L	L	D	E	E	R	R	S	D	U
R	B	A	C	T	E	R	I	A	M	A	A	E	C
O	T	E	R	S	N	A	K	E	U	G	L	C	K
T	E	P	O	N	D	W	E	E	D	O	A	H	W
O	T	U	O	A	A	M	O	S	S	N	M	L	E
Z	L	P	R	H	D	F	U	R	G	F	A	O	E
O	E	A	G	R	A	S	S	D	M	L	N	R	D
A	J	W	A	T	E	R	L	I	L	Y	D	O	H
P	L	A	N	K	T	O	N	L	M	N	E	P	A
K	E	K	I	N	G	F	I	S	H	E	R	H	L
G	E	E	S	E	C	A	T	T	A	I	L	Y	G
O	C	G	M	I	N	N	O	W	B	U	G	L	A
P	H	G	Q	S	R	M	R	E	P	T	I	L	E

algae
bacteria
beetle
bug
cattail
chlorophyll
clam
dragonfly
duckweed
egg

fish
geese
grass
hawk
killdeer
kingfisher
leech
lily
micro organism
mink

minnow
moss
moth
mud
plankton
pondweed
protozoa
pupa
reptile
salamander

snail
snake
spider
toad
waterlily
weed
worm

FOREST (I)

C	A	T	E	R	P	I	L	L	A	R	S	A	P
H	O	N	I	A	P	H	I	D	S	A	O	W	C
E	P	T	T	C	R	I	C	K	E	T	W	A	O
S	O	W	T	C	K	T	D	E	E	R	B	L	C
T	R	I	O	O	S	C	H	I	P	M	U	N	K
N	C	L	B	O	N	H	Z	W	K	P	G	U	R
U	U	L	A	N	D	W	R	A	O	R	S	T	O
T	P	O	C	F	T	P	O	E	C	R	O	W	A
L	I	W	T	N	I	M	E	O	W	V	M	Z	C
I	N	T	E	O	U	R	O	C	D	W	Y	C	H
Z	E	D	R	W	T	F	R	L	K	W	E	E	D
A	O	M	I	L	L	I	P	E	D	E	O	L	C
R	G	R	A	S	S	H	O	P	P	E	R	R	M
D	G	R	A	P	E	M	U	S	H	R	O	O	M

ant
aphids
bacteria
caterpillar
chestnut
chipmunk
cockroach
cottonwood
cricket
deer
earthworm
elm
fir
grape
grass
grasshopper
lizard
millipede
mold
mushroom
oak
owls
pine
porcupine
raccoon
rat
rodent
sap
shrew
sowbug
tick
tree
walnut
weed
willow
wood
woodpecker
woodworm
worm

FOREST (2)

B	A	T	B	S	N	A	I	L	S	N	H	R	M
A	U	D	E	P	S	L	U	G	N	S	E	A	I
B	A	T	E	I	P	Q	V	I	A	V	P	T	C
U	N	S	T	D	A	F	B	P	A	P	P	L	E
C	T	G	L	E	R	O	C	S	L	R	H	V	S
K	M	O	E	R	R	A	B	B	I	T	I	I	T
E	M	O	L	E	O	F	X	E	C	V	C	N	D
Y	A	S	S	W	W	Y	L	E	H	F	K	E	A
E	P	E	F	S	A	D	B	Y	E	F	O	G	Z
A	L	B	E	A	R	M	A	H	N	C	R	X	F
G	E	E	R	W	B	O	B	C	A	T	Y	S	U
L	A	R	M	A	L	T	S	M	S	W	R	E	N
E	F	R	U	S	E	H	U	F	H	A	K	W	G
B	S	Y	T	P	R	S	P	R	U	C	E	P	I

ant
aphid
apple
ash
bat
bear
beaver
bee
beetle
berry
bobcat
buckeye
butterfly
eagle
fern
fly
fox
fungi
gooseberry
hawk
hickory
leaf
lichen
maple
mice
mole
moss
moth
nut
rabbit
rat
robin
slug
snail
sparrow
spider
spruce
sumac
vine
warbler
wasp
wren

ENVIRONMENTAL EDUCATION

C	E	V	A	P	O	R	A	T	I	O	N	U	T	R	I	E	N	T	S	A	A	Q	U	A	R	I	U	M
H	L	I	F	E			D	O	M	I	N	A	N	T	R	E	E	S	E	G	G	U	S	T	A	R	C	H
	U	I	S	H	O	R	E	L	I	N	E		T	R	A	C	K	S	A	E	L	A	N	D	E	A	T	H
	E	M	M	I	G	R	A	T	I	O	N	S	B	U	S	H			S	A	N	D	S	P	R	I	N	G
			I	A	L	G	A	E		C	S		B	I	R	T	H		O		E	R	O	S	I	O	N	
H	O	S	T	D	X	M	O	L	D	O	H	U	M	U	S	E			N			A	N	I	M	A	L	S
B	O	U	N	T	Y	C			M			T	A				I	N	S	E	C	T	I	C	I	D	E	S
W	A	S	T	E	P	H	O	T	O	S	Y	N	T	H	E	S	I	S	H	A	D	E	X	T	I	N	C	T
L	A	K	E			I	M	M	I	G	R	A	T	I	O	N			A	D	A	P	T	A	T	I	O	N
P	A	R	A	S	I	T	E	S	M				E			P	V		S	C	A	V	E	N	G	E	R	O
	F	B	A	L	A	N	C	E	S	U	N		R				R	I		U		S	U	L	T	R	Y	C
C	O	M	P	E	T	I	T	I	O	N	N	P	R	E	D	A	T	O	R		C	H	A	N	G	E		T
H	O				F	O	O	D	C	H	A	I	N	G	R	A	S	S	T	O		C		N			Y	U
A	D	E	C	A	Y	C	O	M	M	U	N	I	T	I	E	S				E	N	W	E	E	D	S	K	R
R	B	I	O	L	O	G	I	C	A	L				Y	Y	W	A	T	E	R	C	M	I	S	T	Y	C	N
A	D	E	S	E	R	T	T	O	U	C	H	L		T	S	P	E	C	I	E	S	T	E		S		Q	A
C	A	R	N	I	V	O	R	E	S	P	L	A	I	N	O	R	G	A	N	I	S	M		N		I	R	L
T	T	M	O	R	T	A	L	I	T	Y		N		F	A	L	L	O	B	S	E	R	V	A	T	I	O	N
E	A	C	O	N	S	U	M	E	R	F	U	N	C	I	E	N	E	M	I	E	S		S	U	G	A	R	N
R	A	I	N	Y	S	M	E	L	L	M	P	R	O	D	U	C	E	R	W	I	N	D	L	I	V	I	N	G
I	N	V	A	D	E	R		P	M	A	N	E	N	E	R	G	Y		F	E	E	L	I	C	H	E	N	S
S			M	I	C	R	O	O	R	G	A	N	I	S	M	T		C	H	L	O	R	O	P	H	Y	L	L
T	E	T	A	S	T	E	C	P	N	A	T	I	V	E	P	N			L	P	X	C	L	I	M	A	T	E
I	T	E	R	R	A	R	I	U	M	G	R	A	P	H	E	A	R	T	H	E	Y				R	I	W	A
C	O	L	D		E	C	O	L	O	G	Y	M	O	I	S	T	C	O	O	L	G	P	R	E	Y	R	I	V
S	E	N	S	E	S	M		A	C	A	M	O	U	F	L	A	G	E			E		N	S	U	N	G	E
P	L	A	N	T	P	A	T	T	E	R	N		G	R	O	U	N	D			N	I	N	S	E	C	T	S
C	L	O	U	D	Y	N	D	I	A	G	R	A	M	S	P		D	E	C	O	M	P	O	S	E	R	S	O
D	I	S	E	A	S	E	P	O	N	D			S	T	E	E	P			S	U	N	L	I	G	H	T	I
P			C	A	R	B	O	N	D	I	O	X	I	D	E	C	O	N	D	E	N	S	A	T	I	O	N	L

ENVIRONMENTAL EDUCATION

adaptation
age
air
algae
animals
ant
aquarium
balance
biological
birth
bounty
brush
camouflage
carbon dioxide
carnivores
change
characteristics
chlorophyll
climate
climax community
cloudy
cold
communities
competition
condensation
consumer
cool
data
death
decay
decomposers
desert
diagrams

disease
dominant
earth
ecology
egg
emmigration
enemies
energy
environment
erosion
evaporation
extinct
fall
feel
food
food chain
fungi
graph
grass
ground
host
humid
humus
immigration
insecticides
insects
invader
lake
land
leaves
lichens
life
life cycle

light
living
man
matter
micro organism
minerals
misty
moist
mold
mortality
moss
native
nature
nocturnal
nutrients
observation
ocean
organism
oxygen
parasite
pattern
photosynthesis
pioneer community
plain
plant
pollution
pond
population
predator
prey
producer
protect
quadrat

rainy
rocky
sand
sandy
scavenger
season
seed
senses
shade
shoreline
slope
smell
soil
space
species
spring
starch
steep
succession
sugar
sultry
sun
sunlight
taste
terrarium
touch
tracks
trees
twig
waste
water
weeds
wind

APPENDIX F

Field Trip

The following material pertains to the field trip preparation, activities, and immediate follow-up in the classroom.

Sample Request to Principal for Field Trip F-2

Field Trip Guidelines for Principals F-3

Sample Letter to the Student's Parents (Choose only one)

1. Requiring a parent signature (Use if the principal requests signature) F-4
2. Not requiring parent signature F-5

Data Sheet (Make two copies for each student) F-6

Field Trip Schedule F-7

General Directions for Group Leaders F-7

Information for Group Leaders to Give Students F-8

River Road Trip Sites F-9

Lecompton Area History F-11

Field Trip Guide F-15

Aids for Group Leaders F-18

Sample Trail Directions F-23

Field Trip Summary Guide F-24

Habitat Studies Comparison Sheet F-25

SAMPLE

F-2

THE TOPEKA PUBLIC SCHOOLS
REQUEST TO PRINCIPAL FOR FIELD TRIP
Elementary Schools

Date Submitted__________

Any classroom teacher who plans to take a group of students on a field trip should discuss the details of the trip with the principal of the school in advance of the date for the trip. In most cases, this planning with the principal should be done two weeks in advance of the trip. This form should be properly completed in duplicate and signed by the teacher and the principal. One copy is filed in the office of the principal and the duplicate is sent to the Office of Instruction to be filed there.

School__________ Grade______ Number of Pupils__________

Date of Trip__________ Leave__________ Return__________

Description of Trip: Leadership will be provided by the Environmental Education Project Staff. The trip will include an environmental study of 1) points of interest along the south side of the Kansas River, and 2) the environmental study site at Perry Reservoir.

Objectives of Trip: 1) To allow the students to view examples of how man is using his environment.
2) To relate the concepts developed during the pre-trip study to the "natural" or real environment.
3) To provide each student an opportunity to use the senses and strand concepts in observing a "natural' area.
4) To collect data from various types of habitats for comparative studies.
5) To develop in each student interest in protecting and maintaining a quality environment.

Means of Transportation: School buses will be provided by the Environmental Education Project.

Required Cost Per Student None other than bringing a sack lunch.

Teacher's Signature__________

- -

I approve the above request and accept responsibilities for the field trip as stated in the guidelines on the reverse side.

Principal's Signature__________ Date__________

FIELD TRIP GUIDELINES FOR PRINCIPALS

1. Have definite educational objectives and procedures for evaluation been established?
2. Is the field trip appropriate for the age level and/or subject area? And can it meet established objectives?
3. Are the educational outcomes commensurate with the time taken from the regular instructional program?
4. Have the students been adequately prepared to make the field trip a worthwhile experience?
5. Has the teacher made adequate arrangements at the field trip site? (Dates, time schedule, guides, safety measures, proper dress, etc.?)
6. Have any of the students within the teacher's group been denied the opportunity to participate? If so, was good judgment used in making the decision?
7. Have arrangements been made for those students who are not participating?
8. Are you aware of the length of time the students will be away from your building?
9. Does the field trip conflict with other scheduled school activities?
10. Have arrangements been made for students to be absent from other classes and to do madeup work?
11. Are substitute teachers needed?
12. Have parents been notified of the field trip and been given an oppotrunity to notify the school and ask that their child be excused from the trip?
13. Do you have on file a parent-signed pupil information record for each child giving permission for field trips (Item 164)? (Principals may wish to require signed parental permission slips for specific individual trips.)
14. Are the transportaiton arrangements adequate and safe? Are the vehicles adequately insured? (Remember that student drivers are not permitted to transport other students.)
15. Is each student required to pay a fee? If so, do you know the total charge and what expenses it covers?
16. Have you made arrangements for those students who state they cannot "afford" the field trip fee?
17. Have arrangements been made for emergency situations?
18. Has the field trip form been completed in detail and filed with the designated offices?
19. Does this field trip conflict with Topeka Plan Policy No. 1122D (1) which prohibits "the giving or attending of paid performances during the school day for which tickets will be sold or admission charged to students"? (This includes commercial movie and theatrical productions.)
20. If you have doubts concerning this trip, have you discussed them with the departmental supervisor or office of instruction?
21. Are you, as principal, "ready and willing" to accept your official responsibility for this field trip?

The Topeka Public and Parochial Schools
Unified School District No. 501
Environmental Education Demonstration Project
Phone. 232-9374

Dear Parent:

Your child's class is studying about the environment. This special study is possible partly because of the approval of a federally funded Environmental Education Project. Materials and information developed by the project staff, teachers, and community resource persons are used to teach this program. This study includes classroom work, a field trip, and follow-up activities in the classroom.

We are planning to take an all day field trip to Perry Lake on_________. We will leave the school at______o'clock and return by______, so it will be necessary for each student to bring a sack lunch. A school bus and a driver will be furnished by the environmental project. If weather permits, the route to the lake will include traveling by the Du Pont and Kansas Power and Light plants, and continuing along the river road to Lecompton and across the river to an ecology site on the east side of Perry Lake.

At least one adult will be present on the trip for each ten students. If you would like to go along as a visitor, volunteer, or teacher's helper, please contact your school.

Please make sure your child is dressed for being out in the weather all day and for walking through rough areas.

Before we are allowed to take your child on this field trip, you must complete the form below and return it to the school.

- -

ENVIRONMENTAL EDUCATION FIELD TRIP

I give my permission for__________________________to go on the environmental education field trip to Lake Perry on_____________and to take part in the activities involved with the trip.

Emergency Information:

Home Phone___________________Alternate Phone_________________________________

Address____

Doctor's Name____Doctor's Phone___________

Please list any physical limitations your child has that we should be aware of on this trip:____

____

____
Signature of Parent

IF YOU WOULD BE INTERESTED IN SERVING AS A VOLUNTEER on some of our future field trips, please indicate below the grade level with which you would like to help. You would be trained for any trip before being put in charge of a small group of students.

Level: _____Elementary _____Jr. High _____Sr. High

The Topeka Public and Parochial Schools
Unified School District No. 501
Environmental Education Demonstration Project
Phone: 232-9374

Dear Parent:

Your child's class is involved in a special study of the environment. This special study is possible partly because of a federally funded Environmental Education Project presently working with the public and parochial schools of Topeka. Materials and information used in this study have been developed by the project staff, teachers, and community resource persons. This study includes classroom preparation, a field trip experience, and follow-up activities in the classroom.

We are planning to take an all day field trip to Perry Lake on__________. We will leave the school at______o'clock and return by______, so it will be necessary for each student to bring a sack lunch. A school bus and a driver will be furnished by the environmental project. If weather permits, the route to the lake will include traveling by the Du Pont and Kansas Power and Light plants, and continuing along the river road to Lecompton and across the river to an ecology site on the east side of Perry Lake.

While at the Perry site, your child will study: 1) interrelationships between plants and animals, 2) similarities and differences between a woodland area, grassland area, a pond, and the lake shore, 3) the effects non-living factors have on the life present in a given area, 4) the effects man has on the environment, and 5) use of the senses to observe the environment.

At least one adult will be present for every ten students present on the field trip. If you would like to go along as a visitor, please contact the school.

Please make sure your child is properly dressed to be in the out-of-doors. If possible, have your child "layer dress" so they can remove a series of sweaters as the day warms, rather than removing one coat. Due to the presence of rocks and thorns at the Perry Site, it would be best if your child wore hard-soled shoes. In case of extreme weather conditions, the field trip will be rescheduled. You will be notified of the new field trip date.

The Environmental Education Project uses volunteers to assist with all field trip activities. If you would be interested in becoming a volunteer for future field trips, please call the office, at 232-9374. We are working with fourth-grade, sixth-grade, special education, junior high and senior high students. Regardless of the student level you might volunteer to work with, we will provide training for you before you will be given the responsibility of working with students.

If you do not wish your child to take part in this field trip, please contact the school principal.

DATA SHEET

Station Type____________________ Name____________________

WEATHER CONDITIONS:

sunny______partly cloudy______cloudy______rainy______
sultry (humid______hot______warm______cool______calm______
windy______slight breeze______Air Temp.______°F______°C

PRODUCERS:

young trees______old trees______shrubs or bushes______
vines______moss______algae______grass______other green plants____

PLANT DESCRIPTION:

tall______medium______short______estimated height of
tallest plants______woody plants______not woody (herbaceous)_____.

SHADE:

part of day______most of day______none of day______
all day______What will cause the shade?____________________

SLOPE:

steep______slight______flat______Indicate direction
of slope____

SOIL: (Use only for grass and wood area)

hard______soft______dry______moist______wet______
erosion signs____________________Soil Temp.______°F______°C

GROUND COVER:

type of decaying matter____________________________________
Is the decaying matter thick__________thin______or missing_______
Is the ground rocky?______Are the plants together______or
widely spaced?__________

WATER: (Use only for pond and lakeshore area)

small waves______large waves______medium-size waves______
clear water______cloudy water______muddy water______
shoreline bare______decayed matter along shoreline______
Water Temp.______°F______°C

On the back of this sheet, construct a food web for this area. Be sure to include producers, consumers, and decomposers.

LAKE PERRY FIELD TRIP SCHEDULE

8:45 - 8:55	Load Students at School
8:55 - 10:30	Travel by way of river road (south side of Kansas River, see river road sites)
10:30 - 12:00	Morning observation using the senses and strand concepts
12:00 - 12:30	Eat and move to starting points for station studies
12:30 - 2:15	Habitat studies using data sheets
2:30 -	Load bus and leave site. Cider slush?

GENERAL DIRECTIONS FOR GROUP LEADERS

1) Have a group roll call system: students number off or a similar method whereby the group can be quickly checked.

2) Provide each student with a drinking cup, thermometer, clipboard, and hand lens at appropriate time.

3) Collect any equipment used by the students at the end of the session.

4) Allow some time for students to use the restrooms. Avoid congestion by having them go when no other group is present.

5) Collect small water samples from either pond or lake or both during the afternoon. The leader should gather the water samples immediately after students have filled the container.

6) Be sure your group stays together.

7) Emphasize leaving the area as little disturbed as possible.

8) In case of a student injury, have the student remain quiet until either a project staff person or classroom teacher is located. They will then decide appropriate action. Severe bleeding or stopage of breathing requires immediate and appropriate action.

9) Avoid talking about something while on the trail until the entire group has caught up to you. If possible, try to get the group in a half-circle around you before you start talking.

10) Don't make a walking marathon, spend some time sitting and discussing various interrelationships.

11) Lecture as little as possible. Ask leading questions to stimulate the participation. Answer a question with a question which will guide him toward giving the correct answer. (Don't overdo this technique)

12) Be enthusiastic in your approach to each topic on the trip. What is "old stuff" to you is probably new to the group.

13) Don't bluff! If you cannot answer a question, say so! Make a note of it so you can later follow it up.

14) Involve the group actively during the trip. As much as possible, encourage the use of all senses.

15) If a student discovers something exciting, stop and discuss it. You [illegible] get back to your topic later.

16) Avoid overdoing detailed and complicated explanations. Keep things simple and general.

17) Avoid a taxonomy (naming) trip. Giving names first causes closure on a topic.

18) Guide student observation toward details of plants and animals, but also be sure they are aware of overall relationships, interactions, and patterns.

19) Use questions to guide student observation.

20) Divide the time so students will be able to view various types of habitats.

INFORMATION FOR GROUP LEADERS TO GIVE STUDENTS

Explain that:

1) It will be a physically more demanding day than being in the classroom. They will need to accept this and not spoil the day for others by complaining (cold, tired, etc.)

2) The students will need to stay close to the leader so they can hear and not get lost.

3) The students are not to disturb nearby groups by yelling or otherwise distracting them.

4) The students are to disturb nature as little as possible, replace any rocks or other objects they move.

5) The students are responsible for the equipment they are using and are to return it to the group leader at the end of each session.

6) The students are to keep their drinking cup all day.

7) When walking downhill, they should step sideways.

8) They are to follow the leader's directions and instructions at all times.

RIVER ROAD TRIP SITES

(South Side of Kansas River)

New Housing Developing - Mostly developed since 1968. What type of land was taken? Which type of housing requires the greatest amount of land per person, apartments or private houses?

Trailer Court - Note arrangement and spacing. Why not build permanent housing? Why are most of the trailer houses set with long axis north-south? Is this a typical trailer court?

KPL - Kansas Power and Light provides electricity. What do they burn to make power? Who uses the electricity? Do they have waste products? What are the big tanks out front?

Du Pont - Makes cellophane. What's cellophane made from? How is it used? How many people work for Du Pont? Do they have pollution problems? How does cellophane differ from plastic?

Farm Crops - Supplies food for man and beast. What plant and animal crops are raised in this area? Do you eat any of them? What food do we eat that are raised in this area?

Rock Fence - Why was the fence made of rocks and not wood posts and wire? What type of material is used today in building fences?

River Flood Plain - A flood plain is the flat area next to the river banks which is flooded during heavy rains. Is the river always in the center of the flood plain? How was the flood plain formed? Does the flood plain make good farm land? Does the river change its location? How is the land above the flood plain used by farmers?

Water Pump Station - Supplies rural people with water. Why do they not use private wells? How does this water system compare to a city water system?

Trash Dumping - Note the various places people have dumped trash on the roadside. Why do people dump trash this way? How would you feel if you owned the land where people throw their trash? Is the dumping by city or farm people? What is being done by the government people to curb trash dumping along the roadsides? What is the greatest problem created by trash dumping?

County Line - Note change in road. What two counties meet? When were the counties established?

Growth Patterns on Hillside - Beneath the trees on the hillside note that some places there is undergrowth, some places it is bare, and some places have thin undergrowth. Try to explain this difference.

Railroad - Note the railroad runs in the edge of the flood plain. Why? What advantage is it to keep the railroad within the flood plain?

Sand Bars - Note the large masses of sand in the river. Where does it come from? Did the river once carry more water than at present? Did the river influence the settling of Kansas? Can you tell which direction the river is moving by the location of the sand bars? Is the water dirty? If so, how did the dirt get into the water?

Lecompton - Was once a pro-slave center in Kansas. Read the article explaining the Lecompton History that is included in the unit material. Why was Lecompton not made the capital of Kansas?

Constitution Hall - How many years old must the Constitution Hall building be? Why was the first constitution that was written for Kansas not used when Kansas became a state?

Lane University - Was built on foundation intended for capital building. President Eisenhower's parents attended Lane University and were married in Lecompton.

LECOMPTON - BRIEF OVERALL HISTORY

Daniel Boone's nephew belonged to a company (working for the government) to find good townsites. They camped on the bluff overlooking the town and decided its location. They called it Bald Eagle because an Eagle flew out as they were discussing names. They felt the site was good because there were seven hills, just like in Rome. The first citizens changed the name to Lecompton for Judge Lecompte. The town was founded in 1854.

Lecompton was chosen to be the pro-slave Kansas capital in 1855 and the capitol building was begun. The town reached its height of prosperity between 1857 and 1858. There were about 1,000 people and lots were sold for between $500 and$1,000. They could later be bought for $25. The town was filled with pro-slave politicians and land speculators and was the site of several small battles between the free staters of Lawrence and Big Springs and the pro-slavers of the area. The first territorial governor built a beautiful, quite elegant home here, but it has since been dismantled. At one time, Lecompton was known as "The Wall Street of the West." However, when Kansas came in as a free state, Lecompton was reduced to a small town. The foundation of the pro-slave capitol building later became Lane University. For further information see the historic buildings and river history listings.

LECOMPTON
(Historical points as approached from 40 North on Lecompton Road)

1. Fort Titus
   Ruins of old Fort Titus (no longer visible) are in the area of the propane tanks south of Lecompton. This was a small fort, built by pro-slavers, of double log walls during pro-slave and free state hostilities. It was used by 13 Lecompton men to hold off a large number of Lawrence free staters. Lawrence, however, had a cannon and the rest of the townsmen took off across the river for safety. The men at the fort surrendered after the cannon was used, but escaped quickly.

2. Lane University - Capitol Foundations
   Construction began in 1855.

   a. Behind the old High school is an old stone building. This was originally to have been the Kansas capital but money ($50,000 from the U.S. Government) ran out after the foundation and first story walls were built. It was to have two large wings added but the foundation of these is now covered.

   b. When Lawrence free staters massed on the bluff to the East to demand their governor (Robinson) be released (he was jailed on charges of treason because the free state party was not yet recognized as the government of Kansas and he was touring as governor) the townsmen took refuge in the half-finished building. The U.S. Calvary at Thacket heard the shooting and came rushing to the rescue with banners waving and trumpets blaring. They pursuaded the Lawrence men to leave.

   c. Lane University bought the property and in 1882 townsmen finished a new university on the old capitol foundations. Eisenhower's parents met at Lane and were married in Lecompton.

3. Constitution Hall
This building is inside the town itself and is still in use as a lodge hall. It is unaltered in looks. This was the site of the signing of the first pro-slave Kansas constitution.

4. Old jail ruins
The ruins are just behind the Constitution Hall on private property. Students may stand on the Hall grounds to look but are not to go onto the property with the jail ruins. This is the jail in which Governor Robinson was kept in 1856.

RIVER AREA HISTORY

1. The river was originally deeper and swifter. A sycamore log ferry was used to cross the river in 1854 at the time the area was opened to white settlers. A 20 foot log, 5 feet wide was hollowed out 2 feet deep and was called the "Fairy Queen". It managed to cross the rapid river using only one paddle. The charge was $2.50 a crossing.

2. Later a ferry boat made of boards (16 feet long, 12 feet wide) was anchored by cables to stout trees on either bank and maneuvered by a pulley. The ferry could carry a stagecoach and six or eight horses, but was usable only during daylight. Occasionally the cable broke when the river was very rapid and the ferry, plus passengers, were rescued from a sandbar downstream.

3. Pontoon Bridge
Many small boats were chained together and a plank build across them as a bridge.

4. Ruins of an old ferry landing (built up of rocks and dirt) is still slightly visible approximately under the power lines running to the West of the new bridge. This is also the site of the old depot. A coal or grain shute remains.

5. Steamboats
From Kansas City to Manhattan, steamboats carried freight and passengers. This was discontinued in 1865 due to dam construction at Lawrence. Many of the 20, colorfully painted, steamboats had to be rescued from the many sandbars. Indian canoes also carried goods and passengers.

6. Recreation
During very cold winters, people could ice skate to Lawrence and back for recreation. Horseback riding was also popular in Lecompton and large groups went for daytime and midnight rides together.

BIG SPRINGS

(South of Lecompton on Highway 40)

1. This was the site of the first free state convention in September 1855. The barn which may have been the original site of the convention is visible from the road. It is now a part-time museum run by Mr. A. W. Schwanke.

2. Big Springs was a watering place on the old Oregon Trail. It was known as the forks because here the traffic from Independence, Missouri spread out to cross the river at various points. Bit Springs was valuable because there were several large, dependable, springs and ponds in the area. Also, the grass was sufficient for feeding the large number of cattle and horses waiting to cross the river.

   In 1844, 10,000 people in covered wagons waited at Big Springs for the spring floods to dissipate so they could cross the Kansas River.

   The Oregon Trail was in heavy use from the early 1840's to 1869 when the railroad came in.

   Faint ruts are still visible from the west side of Lecompton Road, just past the junction of Lecompton Road and Highway 40. This should help to point out the lasting effect that man can make in his environment. The original ruts have probably been perpetuated by erosion after the earth was deeply rutted by the heavy traffic.

RESOURCES*

Collections of the Kansas State Historical Society, 1909-1910. "The Story of Lecompton," an address by Ely Moore, 1907.

This is an interesting, folksy account of early Lecompton by one of the first settlers. It would be good reading for some older students in that it gives a view of events from the Lecompton side rather than the usual free state interpretation.

Early History of Lecompton, Kansas and its Vicinity. "Lecompton Rural High School, 1934."

This is a history of early Lecompton and has a description of the historic buildings and their functions There are pictures of some buildings which have since been torn down.

History of the State of Kansas. A. T. Andreas, Chicago, 1893. p. 352 "Lecompton History," p. 353 "Big Springs," p. 584 "Tecumseh," p. 308 "Douglas County."

Douglas County Clippings, Vol. 3, Kansas City Journal, September 1902, "In Days of Lecompton."

A short history.

*These items are available from the Topeka Historical Museum Library

LOCAL REFERENCE PEOPLE

Lecompton

Mrs. Frank Walters--sixth grade teacher and resident of Lecompton. She has made a study of the history and uses it with her own classes.

Big Springs

Mr. A. W. Schwanke owns the old barn, dating from Oregon Trail days and has a small museum of articles he has collected. The museum is not generally open but could be by appointment if interested in further history of Oregon Trail and first free state party.

FIELD TRIP GUIDE

This guide is intended for use by the leaders during the field trip.

For further examples and suggestions of ideas for use during either the morning or afternoon read the following appendix material "Aids For Group Leaders."

Morning Session at Lake Perry 10.30 - 12:00

Give each student a hand lens and show how it is used. Don't forget to collect them at the end of the session!

During this session, help the students use each of the five senses, use the strand concepts to observe local examples of food chains, determine the basic needs of plants and animals and discuss how the organisms meet these needs, and discuss the matter cycle. The following concepts should be covered using a similar example. These concepts can be combined.

Concept	Example
Senses	
Feel	Touch surface of leaves, bark, worn rocks and freshly broken rock.
Smell	Smell soil, crushed leaves, and flowers.
Sight	Have each student select one thing he sees and describe it the best he can.
Taste	Taste only things you are sure are safe, such as grass, moss, and algae.
Hearing	Towards the end of the session, sit quietly and listen for sounds produced by living and non-living things.
Strands	
Similarity	Lead discussion describing how two trees (hickory and elm) are alike.
Variation	Discuss and compare differences. Use tree leaves (oak and walnut); plants on top of the hill and those on the bottom; bark patterns on trees.
Adaptation	Examine the thorns on a gooseberry plant or locust tree. Some plants grow better in sunny areas, other in the shade.
Change	Discuss how the Lake Perry area will change with different seasons. What did it look like one million years ago?

Concept	Example
Strands	
Interaction	Find evidence of animals eating--holes in leaves and nutshells. Find tall trees shading undergrowth, wind blowing leaves; rocks weathering; logs decaying.
Patterns	Look for patterns in leaf veins, leaf margins, tree limbs, tree bark, plant growth, bird nests, waves, and rocks.
Basic Needs	
Animals	Animals need food for energy from green plants or other animals that have eaten green plants; oxygen from the air and water from a lake, pond, or stream.
Plants	Discuss what the green plants need in order to live: carbon dioxide from the air, water and minerals from the soil, and energy from the sun.
Matter Cycle	
Plant Waste	Green plants release excess oxygen into the air.
Animal Waste	Animals release carbon dioxide and undigested matter.
Matter Cycle	Discuss the movements of matter from the soil, through the food chain, and back into the soil. Discuss the exchange of oxygen and carbon dioxide between plants and animals.
Food Chain	
Producer	Have the students point out examples of producers (green plants) in the area: trees, shrubs, algae, moss, weeds, grass.
Consumer	Find examples based on observation and evidence: teeth marks, tracks, and animals.
Decomposers	Find examples: fungi, mold, worms.
Food Chain	Based on the evidence observed, develop food chains for the area. Start each food chain with a producer, include at least one consumer and end with a decomposer. Example: (shrub--deer--coyote--bacteris), (algae--minnow--crayfish--catfish--bacteria).

Afternoon Session (Habitat Studies) 12:30 - 2:15

Each student will be provided with a clip board, thermometer, compass, and two copies of the data sheets (see unit page F-6). Students should have pencils, but each leader will need extras.

Observations will be made of plants and animals in a woodland, grassland, pond, and lakeshore. A data sheet will be completed in two of the areas selected by the leader. See page 29 in the unit for more details.

Directions for Using the Data Sheet

Station Type Indicate the type of area being observed - woods, grassland, pond.

Producers: Discuss the role of producers (making food), then check the groups of producers found in the area being studied. What are the basic needs of the producers and where do the producers obtain these materials?

Plant Description: Discuss relative value of words like tall and short. Let the students complete their sheet. Do not try to have all students agree on one specific answer.

Ground Cover: Emphasize variation in types of decaying matter with types of plants present. Relate size of plants to space between plants.

Shade: Relate angle of sun, presence of trees, and slope of hills to the length of exposure.

Weather Condition: Check the terms that best describe the specific area you are in.

Air Temperature - Be sure students hold the thermometer away from their body at least six inches for one minute before reading.

Soil - Feel with fingers.

Erosion Signs - Compare erosion in the area with that viewed near Lecompton.

Soil Temperature - Dig a small hole one-inch deep with a stick or pencil, then place the thermometer in it. Do not push the thermometer into the ground as it will break.

Clear, Cloudy, Muddy Water - Place a small sample of water into a clear bottle and observe. Compare the sample to the larger body of water.

Water Temperature - Be sure to measure air temperature first--a wet thermometer will not measure air temperature accurately on a windy day.

Food Web: Draw a six-inch circle on the back of the page and make dots every inch around the circle. Now start naming plants and animals that live in the area. Place their names outside the circle by the dots. Be sure your food web includes producers, consumers, and deocmposers. Draw lines indicating what eats what.

AIDS FOR GROUP LEADERS

As each group will encounter different environmental situations, no set guidelines can be formulated. The following are suggested guide questions, each set based on the group stopping at a given type of location.

A) Woodland

1) What is the overall pattern of tree growth? (loose, tight, many branches, few branches, leaning one direction, big branches, small branches, large tall trunk, branched trunk, distribution of branches around the trunk)

2) What are some patterns produced by tree parts? (leaf veins, leaf margins, leaf arrangements, bark of older parts, bark of young twigs, bud arrangement, bud cover, growth of lichens on trees, angle of branches, insect damage to tree leaves) (Use sense of touch, smell, and taste as well as sight where possible)

3) What organisms depend on the tree? (Insect damage, bird nest, insect homes in bark, mammal homes, evidence of squirrels eating)

4) What are some signs of interaction of the tree with other environmental factors? (birds lighting on branches, wind moving leaves, roots in soil, effect on other vegetation around, role in carbon dioxide-oxygen cycle, weather affects)

5) What role does the tree play in the food web? (producer for many organisms)

6) How is a specific tree different and similar to surrounding trees? (size, age, patterns of parts)

7) How is the tree similar to surrounding vegetation? (attached to soil, act as producers)

8) How many, and what, colors can be found on the tree? (several by close observation)

9) Are there any signs indicating the tree is reproducing its kind? (seed, fruit)

10) Does a crushed leaf produce a definite smell?

11) Has man influenced the tree?

12) What grows directly under the tree?

13) What type of shadow is produced by the tree?

14) What adaptations does the tree have for protection? (thorns, thick bark, sticky sap)

15) Does the tree produce any sound?

16) List adjectives that can describe the tree.

17) How has the tree adapted to the season?

18) How has the tree's location affected its growth?

19) How many types of trees can be found in a 30 foot circle?

20) What plants can be found growing on the trees?

21) Which type of tree is most common?

22) How do plants travel, or do they?

23) What types of organisms are associated with dead trees?

24) Can you tell where last year's leaves were attached?

25) Where are wooded areas located?

26) Are all buds the same shape and arranged in the same pattern?

B) Grassland

1) Is there only one type of plant?

2) Is all grass alike? (margins of blade, base shapes, vein pattern, feel, texture, color, smell)

3) Where does grass grow? Do different grasses grow in different habitats?

4) Are all plants the same height in grassland areas?

5) What animals are found in grassland areas? (Look not only at the top of the grass, but also near and in the soil surface)

6) In what way has grass adapted to allow animal traffic and wind movement? (very flexible blades)

7) What is the root pattern of grass plants?

8) What is the role of grass in the food chain?

9) What type of consumers are found in the grassland?

10) Is there any evidence of large animals being in the grassland? (grazing, tracks, waste material)

11) What type or variety of insects are present?

12) How has man influenced the area?

13) What sound can one hear from the grassland area?

14) What evidence can be found to show nature reuses matter? (decaying matter)

15) Are there any indications of reproduction?

16) Are there any indications that the area is changing?

17) How are organisms using the area? (homes, food, protection)

18) How is the season reflected in the grassland?

19) What smells are present in grasslands?

20) Can you detect any communications occurring between organisms?

21) Is there any evidence of organizational patterns present? (insects)

22) What do some plant seeds taste like?

C) Rocky Area

1) Is the area rocky, due to natural or manmade factors?

2) What patterns can be observed in the rocks?

3) Feel the rock, is it smooth or rough? Sharp or rounded edges?

4) Are all rocks the same size? What causes differences?

5) What affect does weather appear to have on the rocks?

6) What animals associate with the rocks?

7) What plants associate with the rocks?

8) Is the soil different around rocks?

9) How do you communicate with a rock--or do you?

10) Of what value are rocks to animals?

11) What about the rock tells how long it has been exposed? (The sharp and rounded edges)

12) Are the size and weight of rocks always proportioned?

13) Do rocks move? How?

14) Any evidence of former life?

15) Any forms of erosion present?

D) Water Area

1) What are some adaptations of animals that allow them to survive, either partially or completely in water?

2) What vegetation is found in the water?

3) What is different about the soil around water?

4) What evidence is there of other organisms using the water?

5) How do the various organisms interact?

6) Are there any smells associated with water? If so, describe.

7) How do the water organisms depend on the surrounding area?

8) What is found where the water and soil meet?

9) What color was the water?

10) Are there any indications of seasonal influence?

11) Where are the plants located within the water?

12) What is different about the plants at the water's edge as compared to those a few feet out?

13) Do all sides of the pond appear to support some vegetation?

14) What interaction has occurred between the water and the surrounding soil?

E) Summary Questions

1) What type of vegetation is found where grassland meets woodland?

2) How has man changed the wildlife in the area?

3) What are some ways the grassland influences the water? (controls the washing of minerals into water)

4) Does the position of the sun during the day influence the location of vegetation?

5) What indications are there that the area is changing? (pond filling, young trees expanding into grassland)

6) How has man modified the area? (Most of the grassland was planted, burned the underbrush, construction of pond and lake, established recreation area, mowed some of the grass)

7) What happens to the vegetation as one goes from the hilltop to the lake shore?

8) What information should man collect before further modifying the area? (What organism will be destroyed? What erosion will be introduced? Will the value resulting from the change be greater than the value lost?)

9) What will be the natural changes for the area?

10) How would you change this area?

11) Can you find evidence indicating how the area was used before it became part of the Perry Reservoir?

12) What natural resources are present on the site?

13) Where does the water in the pond come from?

14) Where does the water in the lake come from?

15) How many different ways can one pick up environmental communication? (use of all the senses)

16) What danger signals can you read from the environment which tell you the land has been misused?

17) What type of material is decomposing in each area?

SAMPLE TRIAL "A" DIRECTIONS

During the afternoon habitat study each group will follow a compass trail and complete data sheets comparing various habitats. Following is a sample set of trail directions used by one group. Leaders modify and change the trails to prevent wearing paths and to best utilize the area throughout the season.

1. Start at outhouse SC8.
   Note the plants man has introduced into the area.

2. Go 180 degrees south 100 paces.
   Do a grassland study plot at this location. Take a special note of the surrounding area. What appears to be happening?

3. Go 270 degrees west 70 paces.
   Examine the old dead tree, note animal homes, mans influence, and the natural process the area is undergoing.

4. Go 210 degrees south by southwest 80 paces.
   At this point note the invading of the grassland by trees. What type of trees are most common?

5. Go 270 degrees west 70 paces.
   What is happening in this area? Are the trees nearly the same size? Can you find any hickory trees? If so, do they appear to be the same age? How can you tell?

6. Go 340 degrees north by northwest 50 paces.
   Be careful not to slip on the rock while going downhill. Stop and do a woodland plot study at this point. This area has been burned over.

7. Go 240 degrees west by southwest 150 paces.
   From this point do a study of the pond.

8. Go 180 degrees south 100 paces.
   You are now in a woodland area that has not been burned. Compare it with the previously studied woodland area.

9. Go 224 degrees southwest 53 paces.
   Notice the dead log and the natural community involved.

10. Go 270 degrees west 74 paces.
    What happens to the wooded area? What type of trees are most dominant? Do you see a sycamore tree? What is different about it?

11. Continue 270 degrees west 150 paces to the lake shore line.
    What is unusual about the oak trees you passed on the way? How has man influenced this area? What plants are found around the shoreline on the soil? What are the waves doing to the bank? What color is the water? Fill out a study sheet for the lake shore area.

FIELD TRIP SUMMARY GUIDE

Use the last five to ten minutes of the time with your group to review the items listed on this sheet. This is intended to: 1) summarize concepts and ideas for students, and 2) give the group leader information from which he can modify future trips.

Each student should be able to recall at least one example for each of the strand concepts and provide one instance in which each sense was used in observing.

What did they consider the most worthwhile during the field trip?

What did they dislike about the field trip?

What do they have questions about?

Give an example for each of the following, as experienced during the field trip.

Similarity -

Variation -

Patterns -

Interaction -

Change -

Adaptation -

Touching -

Listening -

Seeing -

Smelling -

Note: This can also be used by the classroom teacher as a guide in a follow-up discussion.

HABITAT STUDIES COMPARISON SHEET

Type of Habitat (woodland, grassland, pond, lakeshore)	Temperature and Weather (humidity, shade, etc.)	Soil or water conditions (temp., slope, ground cover)	Animals	Vegetation	Comments